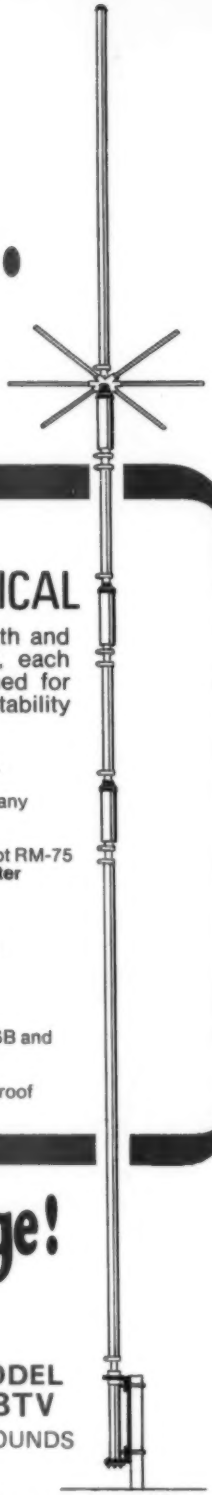
73
AMATEUR RADIO
APRIL 1976
$1.50
FM Special Issue
With I/O -Computers Are Ridiculously Simple!

if the 4-BTV weighs 39% more... what do others leave out?



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Hold it!

Take hold of SSB with these two low cost twins. ICOM'S new portable **IC-202** and **IC-502** put it within your reach wherever you are. You can take it with you to the hill top, the highways, or the beach. Three portable watts PEP on two meters or six!

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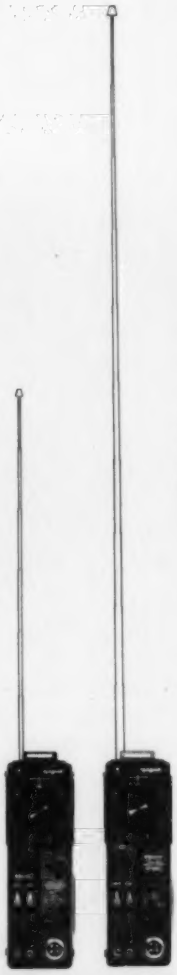

IC-202
2 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 200KHz
VXO Tuning • 144.0, 144.2 + 2 More! • RIT!

IC-502
6 Meter SSB • 3 Watts PEP • True IF Noise Blanker
Switched Dial Lights • Internal Batteries • 800KHz
VFO • RIT!

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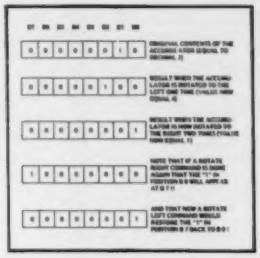

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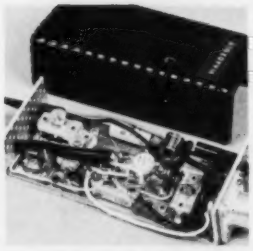

COVER: Nancy Cluff with the Yaesu FT-221. Photo by Ed Crabtree; dogs and sled courtesy of David Houston, Jaffrey NH.

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EDITORIAL BY WAYNE GREEN

HAPPINESS IS A NEW RIG

One of the greatest joys of hamming is getting on the air with something new . . . a rig, an antenna, a new mode. Unfortunately, one of the more frustrating aspects of hamming is trying to find out what to buy.

At the heart of the problem is the fact that there are too few amateurs to present a market for ham gear which attracts larger and better organized companies — thus most of the ham gear manufacturers are small outfits, often run as much as a hobby as a profit-making business. It is no fault of the entrepreneurs who run these companies that they can't afford high-powered advertising agencies to write and produce their ads . . . marketing and research consultants to determine the sales potential of products and to see that they are made and delivered on a schedule . . . professional writers to prepare spec sheets and ad brochures . . . etc.

Few men have had the experience it takes to be familiar with all of the aspects of managing a manufacturing firm . . . they may be good engineers . . . or good salesmen (has there ever been one person good at both?) . . . or they may know marketing . . . yet, when they start their own company, suddenly they are expected to be experts in all of these fields, each of which takes years to learn. They also have to know accounting, production, corporate financing and management, stocks and bonds, how to let contracts, printing, packaging, shipping, etc. Just the business of getting familiar with shipping routines is a job in itself, with hundreds of trucking firms to sort out, a weird assortment of mail rates, UPS rates, etc.

Is it any wonder that many of the ads for ham gear are written more from the viewpoint of the manufacturer than from the prospective buyer . . . you? Is it any wonder that getting information about a new product is sometimes an almost impossible exercise? The ads say little; you send for info and either get nothing or else perhaps a copy of the ad. Here you are waving your money and the manufacturer seems to be doing everything he can to push you off.

Add to that the problem of getting delivery. Maybe you decide that you really must have a certain rig. You try to find a dealer ad for it and there isn't any. Or perhaps you do find one, call the dealer, and find that he thinks he will get a unit for you in six weeks (six months is not unusual on some gear).

A POSSIBLE CURE

One thing that might help this whole situation would be some feedback to the dealers and manufacturers of how you, the customer, feel about what is happening. In practice, we've been doing quite a bit of this already, but without any serious organized effort behind it. Many readers, when they get frustrated enough, write to us and plead for help. In many cases we have been able to break things loose.

It seems to me that this should be expanded. I think that the industry would react well to better feedback from customers. I may be biting off more than I can chew (I do that every now and then), but I'd like to enlist your cooperation in an experimental feedback test.

First, there are the ads. If you are unable to find an ad for something you want to know about, drop me a line . . . mark the letter "Feedback" so I will give it priority. It is awfully frustrating to want to know about something and have to look through a year of back issues to try and get data on it. Manufacturers should advertise up to date listings of gear and prices so they are easily available.

If the ads do not tell you what you want to know, write Feedback. Ads should be written from your viewpoint, not the manufacturer's . . . they should explain what the benefits are to you in using the gear, what it costs, and where to get it.

If you send for Reader's Service (and I've been meaning to speak to you about that . . . you have *not* been sending in your reader's service coupons and I know who you are, you slacker) and info is slow in coming or insufficient, write Feedback. That holds for RS for any hamrag, by the way, not just *73*.

If you have trouble with any dealer, write Feedback. Please be sure that you are being absolutely honest with me . . . if you are screwing around with a dealer and are trying to pull a fast one, don't bring me into the hassle. Be sure you are honest about this and have not been fooling yourself because you pulled a stupid stunt and don't want to admit it. I pull 'em too and it is painful to face up to such things. The motto on my wall is comforting . . . "Intelligence is No Impediment to Stupidity."

If you get spec sheets or brochures which leave you cold, write Feedback. If you get hung up with a rig or kit which is a rip-off, write Feedback.

As far as I know, *73* is the *only* ham magazine which puts its loss of money where its editorials are . . . *73* refuses to run ads for firms which appear to be ripping off the readers . . . or causing them severe headaches . . . or seem to be ripping *73* off. It only amounts to a few lost pages of ads a month . . . perhaps a loss of about $5000 a month in ad revenue, about the cost of a 32 page section of the magazine. Would you rather have another 32 pages of magazine and have to worry about being ripped off by an advertiser?

Send your comments to:

FEEDBACK
73 Magazine
Peterborough NH 03458.

One other thing . . . please don't write and ask which firms are not permitted to advertise in *73* . . . our lawyers insist there is no way to pass along this information without opening ourselves to possible legal harassment. Sorry about that.

CHARLIE THE BOOTLEGGER

The anarchy on the CB bands promoted by the FCC's giving up on any serious effort to contain the action there seems to be spreading . . . to the ham bands. Not that we haven't been sort of expecting this.

The use of Yaesu ham rigs for CB sideband is proving a serious temptation for some of the more adventurous CBers. When they run out of steam on the 23 CB channels they start tuning the 10m and 15m bands and hear a lot of silence. What the hell, the FCC doesn't do anything to them on 11m when they ham, run high power and work skip, so they fire up on 15m and give it a try.

One group tried this in an outskirt of New York recently and got stomped by local hams who got the FCC into the act and squashed the CB expansion effort. We need a lot more hams, but that isn't the way to go about it. This was in Far Rockaway.

I'd like to hear from ham groups who are having problems with CB expansion . . . and what they have done about it. I have a feeling that it is time for the home building crew to get busy and come up with some good direction finding gear so we can form posses and find these chaps quickly. It may be that a visit from a half dozen or so hams will convince them to go back to the old 23. If it doesn't, the

When you get tired of compromises...

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The TS-700A is available at select Kenwood dealers throughout the U.S. For the name of your nearest dealer, please write.

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Electronic International Service Corp.
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Electronic Module
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Gary Radio, Inc.
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Gresham Electronics
133 S.Pennsylvania,Indianapolis,Inc.46240
Ham Radio Center
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Ham Radio Outlet
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Hamtronics
4033 Brownsville Rd.,Trevose,Pa.19047
Harrison Radio Corp.
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Henry Radio, Inc.
11240 W.Olympic Blvd.,Los Angeles,Ca.90064
Henry Radio
931 N.Euclid,Anaheim,Ca.92801
Henry Radio Company
211 N.Main St.,Butler,Mo.64730
Hobby Industry
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Hoosier Electronics
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JRS Distributors
646 W.Market St.,York, Pa.17404
Klaus Radio, Inc.
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Merwil Supply Co.
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Portland Radio Supply
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1710 Joan St.,Baltimore,Md.21204
Radio, Inc.
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Radio Supply & Engineering
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Sara Rose & Spencer Electronics
1465 Wells Station Rd.,Memphis,Tenn.38108
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Srepco Electronics
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Vickers Electronics
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*These are the only dealers authorized by Trio-Kenwood Communications, Inc. to sell and service Kenwood products.

FCC will need as much help as it can get in the way of names, addresses, recordings, etc.

Oh, before I forget . . . it is legal to make recordings of CBers on the CB bands if they are breaking the law. The secrecy rules state specifically that they do not hold if any law is being broken . . . and when was the last time you heard a CBer not breaking the law . . . at least by not using his call? There are no restrictions to making tapes of ham band activities . . . the secrecy rules exempt ham transmissions.

WHEN DOES MY SUBSCRIPTION EXPIRE?

Those two numbers under your call letters on your subscription label are the key . . . the first indicates the month and the second the year of your last copy . . . 56 would expire with the May 1976 issue. Now you know as much as we do.

A FIRST?

I claim the first bicentennial QSL delivery for 1976 . . . any arguments? The contacts were made at 0620 EST (no record, of course) and the *73* bicentennial QSL cards were delivered in person to AA1KPS and AC1PVF at 0727 EST January 1, 1976. The contacts were made on two meters from Peterborough NH to the stations in Somerville and Concord, Mass. The cards were delivered in Concord NH. Chuck, Sandy and I were on a field trip to check out some HTs under working conditions. Chuck, who runs Tufts Radio (New England's largest ham distributor), makes it a point to know how good the gear is that he is selling . . . and I have to know how good the equipment is so I know whether or not to accept ads from the manufacturers. Truly dedicated people such as us willingly give up our New Year's Day holiday to work hard under rigorous conditions for your benefit . . and to get in a little skiing.

SAROC – AN EXPENSE ACCOUNT VACATION

After skipping the SAROC hamfest for several years I made the trip down again to see what, if anything, had changed. Not much had. FM has taken a back seat to microprocessors in the exhibits, but that was to be expected since this is the wave of the future for amateur radio.

Exhibitors were enjoying the pleasures of Vegas during the evenings and griping about the scant turnout of hams during the days. January is definitely the off season in Vegas and, other than amateurs and an embalmers' convention or something, not much was doing and the big acts were out somewhere else. Buddy Hackett (one of my favorites) was up in Aspen skiing.

The Smothers Brothers were there. I've been one of their fans for many years . . . starting with their record albums, way before they got into TV. They were great, as usual. I understand that Dick is an amateur, by the way.

Other than the few manufacturers' exhibits, little seemed to be doing with the hamfest. The biggest attractions were the microcomputers . . . one by Hal using the Motorola 6800 chip had a first rate game of 21 set up . . . most appropriate for Vegas. It afforded an opportunity to gamble without losing money . . . and that is indeed unique in that city. Not that I should gripe about the gambling . . . this time I won.

That's right! And at the game giving the worst odds in town . . . Keno. Along about my third $1 game I came up with four out of four numbers and an amazed cashier paid out $114. I was so flabbergasted that I put some dimes in a slot machine and made a bingo there too for $10 more. I changed it all into bicentennial silver dollars and had the whole works stolen a couple days later out of my hotel room. Easy come, easy go.

The MITS systems were on display, being pushed by The Computer Store of Los Angeles. This was my first look at the MITS Altair 680 (using the 6800 chip) . . . surprisingly small package. I got my first look at the Jolt computer. It uses the Fairchild F8 chip and was an impressive unit. I'd have pictures of all this for you, except I didn't lock my cameras up in my hotel room and they got swiped along with the bicentennial silver dollars. From now on it's a metal suitcase with a good combination lock and a bicycle locking chain to go around something in the hotel room which can't be removed. If they want my suitcase they'll have to take along the sink.

SAROC is a nice expense account vacation for the ham industry.

ITU PREPARATIONS

Past amateur preparations for International Telecommunications Union conferences have been less than minimal, despite $100,000 being set aside for just that use. We went into the last big frequency conference in 1959 with virtually no planning and with no requests for more amateur bands which could then be used as bargaining chips. Through an incredible lucky fluke, U.S. amateurs did not lose out that time.

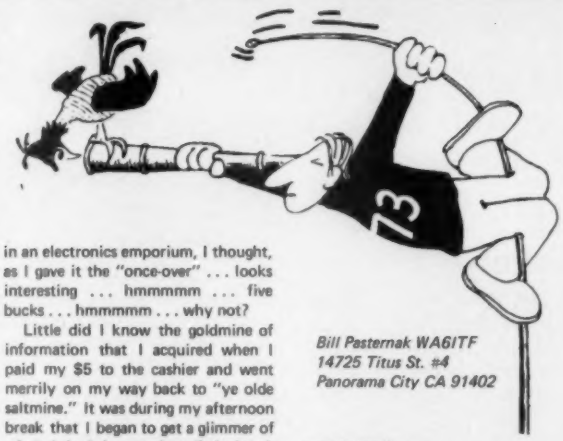
The more recent satellite ITU conference had almost as much planning and the end result was that amateurs suffered a catastrophic loss . . . 99.99% of the UHF frequencies were lost, with only a tiny segment on 450 MHz remaining. All the great ideas for worldwide amateur microwave systems via satellites went down the tubes . . . all because there was no planning, even though the money was there to pay for it.

Happily, things look brighter this time. The next ITU conference is scheduled for 1979 and an amateur committee has come up with some requests for expanded and additional ham bands. If this looks extravagant, remember that at one time amateurs had 7000-8000 kHz and 14,000 to 15,000 kHz, too. And how about that ULF band!

The frequencies suggested in the first draft of the amateur WARC-79 allocations table are as follows (from the West Coast DX Bulletin*):*

160-200 kHz	*420-450 MHz*
1715-2000 kHz	*902-928 MHz*
3500-4000 kHz	*1215-1300 MHz*
7000-7500 kHz	*2300-2450 MHz*
10100-10600 kHz	*3300-3500 MHz*
14000-14500 kHz	*5640-5925 MHz*
18100-18600 kHz	*10000-10500 MHz*
21000-21500 kHz	*24-24.25 GHz*
24000-24500 kHz	*48-50 GHz*
28000-29700 kHz	*71-76 GHz*
50-54 MHz	*165-170 GHz*
144-148 MHz	*240-250 GHz*
220-225 MHz	*300 GHz and up*

Looking West



Bill Pasternak WA6ITF
14725 Titus St. #4
Panorama City CA 91402

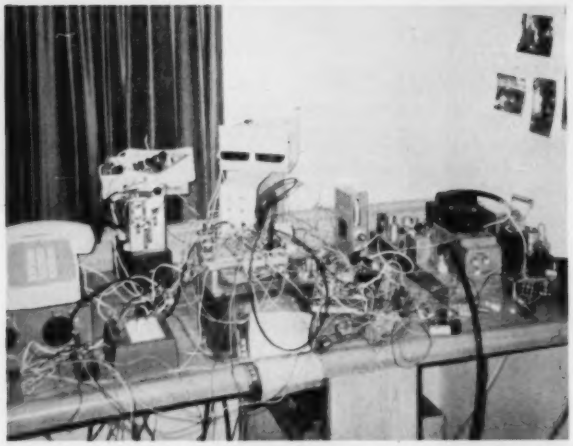
Now that was one #$&% of a football game they played out here today. Possibly one of the biggest upsets in football history. If you are one of the few that missed it, I am talking about the Rose Bowl game played here in Pasadena but a few hours ago. Ohio may have gone in as the favorite, and that first half it seemed like our local UCLA team had forgotten how to play football, but somewhere "the gods" were smiling on us and what took place in that second half. Well, I guess it's one for the record books! You can't imagine in your wildest dreams the joy that abounds in LA tonight. "Our boys done did it, so celebrate!"

We have spent a lot of column space the past few months on the topic of amateur radio public relations – getting the word out to the general public. I had intended to devote this month to but one topic: VHF-FM in the sunny southland, and in fact most of this column will be just that. However (oops, there's that word again), I came across a book in my travels around the San Fernando Valley that bears mention.

Actually, it was just after mailing last month's column to Peterborough during my lunch hour. Having wolfed down one of Grassi's fantastic Italian sausage sandwiches and a Coke, I still had about 25 minutes before I was due to be back at work. I decided to stop by Sandy's Electronics in Canoga Park to see if any new and interesting goodies were to be found. I was browsing through their bookcase when my eye was caught by a rather interesting title, *The Super 8 Handbook*. Rather an odd volume to find in an electronics emporium, I thought, as I gave it the "once-over" . . . looks interesting . . . hmmmmm . . . five bucks . . . hmmmmm . . . why not?

Little did I know the goldmine of information that I acquired when I paid my $5 to the cashier and went merrily on my way back to "ye olde saltmine." It was during my afternoon break that I began to get a glimmer of what I had in my hot little hand. First, it reads like I try to write – simple and to the point. You do not have to be a pro in the motion picture industry to grasp what the authors are trying to say. It starts by explaining in simple terms what Super 8 MM photography is and how it differs from other motion picture formats. It takes you step by step through every phase of Super 8 photography, and when the need arises, it stops to explain itself.

Want to know how to set up proper artificial lighting? See page 79 under filming techniques. Want to learn how to edit your film so that no splices are ever seen? Start on page 155 and keep going. There is even a construction project or two such as an inexpensive home brew camera dolly. I cannot begin to tell you the wealth of information cleanly and clearly packed into those 240 pages by the authors



First, a visit to the site of the ultra-sophisticated Sylmar autopatch repeater WR6AJP.

George D. Glenn and Charles B. Schloz. They are award-winning Super 8 filmmakers and tell a lot about how they did it in this volume published by Howard W. Sams & Co., stock #21001. If what I have written in the past about this motion picture format interests you, then I suggest you get a copy of *The Super 8 Handbook* even before you hit the local photo shop to look at equipment. If you do, you will know a lot about what you are looking for before you enter the door. For what it's worth, I hereby give *The Super 8 Handbook* ten gold stars and the "official" (?) Looking West recommendation. Now on to FM . . .

Let's wind up the coverage of the Ventura Convention and the SCRA meeting held there. As to the convention itself, I would be a poor person to judge, as I arrived late and never got a chance to visit the exhibits or partake of the seminars. In the gripe department, I have only one, and it has to do with the banquet. I am not one who believes that at an affair such as this one should have to stand in line, cafeteria style, to get one's dinner. To me, "dinner" or "banquet" suggests service to your table and all the trimmings that go with it. Again, this is purely personal, and the only negative I came upon that evening. On the positive, the food was good and the people sponsoring the convention came up with a special after-dinner treat that more than made up for the food line.

Now I ask you, how many conventions have you been to where you ate good food, listened while a keynote speaker like Roy Neal K6DUE held your mind captivated, and ended the evening with Alvino Ray and his orchestra? That was the bill of fare presented for those attending Ventura '75. I definitely enjoyed it; I think you would have, too. As I write this, close in my mind is SAROC '75 to which I will soon travel. Well . . . that report is next month!

Meanwhile, back at the SCRA meeting . . . quite a bit of time was spent discussing the problem of uncoordinated repeaters, but no concrete solutions to the problem were derived. The problem is that voluntary frequency coordination is just that — voluntary. It's a handshake among amateurs, and when one or two amateurs don't want to partake of that communal handshake, what can you really do? Keep offering that "hand" is one thing that most everyone attending agreed on. Keep trying to develop lines of communication with the owner of such a system, and do your best to make him "see the light." In one such conflict, it looks as if this approach is meeting with success. When they realize it is to the mutual benefit of all parties, amateurs really can learn the art of communication. Communication is the first step toward negotiation, and negotiation is therefore the first step toward solution.

Personally, I tend to prefer having any differences within our "community" settled from within. It is now a historical fact, one well proven by past experience, that when you are forced to go to the Commission for assistance, most of the time this assistance comes in the form of rather stringent regulation. After having fought hard for a good number of years to eliminate all or at least most of the effects of 18803, we do not want to make any move now that would turn the clock back for us.

It is still my belief that the simplest solution lies in some form of official recognition by the Commission of the work being done by regional frequency coordinating organizations. Note that I say coordinating organizations, not individual coordinators. I feel very strongly that a coordinating organization, whether it is called committee or council, should be made up of representatives from not only the ranks of repeater owners, but also from regional organizations representing all interests (repeater FM, simplex FM, remote base operation, AM and SSB use, and other more exotic modes). The concept of the individual entity (amateur) acting as an area coordinator is one that I personally do not agree with. Not that there have not been some truly outstanding people taking on this burden and doing an exemplary job, but is it fair to all? Is it possible for any individual to be totally objective in a situation where possibly one of his or her best friends is involved? Remember, coordinators like all of us are human beings — people — and no person that I know could be termed as perfect. I know that I am not, and I doubt if I could remain totally objective in every case or in every dispute that would come my way if I were a frequency coordinator. It is for this very reason that I doubt if the Commission would be inclined to "officially recognize" any one individual amateur in a given area as "supreme voice" on such matters.

On the other hand, a coordinating organization, one made up of all interested inhabitants of a given segment of spectrum, is a horse of a different color. By the very fact that no two people think exactly alike on all matters, you have built-in controls and are forced to develop organizational guidelines directed to benefitting the vast majority. Giving each repeater owner an equal voice in all matters affecting VHF-FM repeater operation has proven its true viability. I suspect that this simple precept has been the key of success for the SCRA and other similar organizations. Now, with the recent introduction of a number of multi-mode all band coverage radios for two meters (and unless I miss my guess, similar equipment in the future for 50 MHz, 220 MHz and 450 MHz), it will soon be incumbent upon anyone involved in frequency coordination to take steps to insure the sanctity of users of these other modes, for as more and more of such radios proliferate among our numbers, this will become a necessity. If organizations that are now involved in repeater frequency coordination take the initiative and solicit the most knowledgeable users of these other modes into their organizations, it may well prevent chaos from developing in the future. It will also show the Commission that repeater/FM enthusiasts are not isolationists. It will show that we are interested in the welfare of all spectrum users, and may be the kind of key necessary to obtain that sign of official recognition that is now so necessary.

If this sounds a bit different than the recent ideas set forth by the ARRL, I must at least credit them for putting "the bug" into my head about where the future might lead. While the basic ideas are sound, from the foregoing you probably guess I do strongly disagree with the concept of a Regional ARRL Appointed Coordinator. No matter how strong the controls from Newington, it would be too easy for a monarchy to develop should the wrong person wind up entrusted with the future of a given area. Rather, I would like to see the League solicit the formation of coordinating councils in areas now served by a single amateur acting as coordinator, and simultaneously recognize existing councils as the official representatives of those areas in which such councils exist.

Step two might be the formation of four area-wide organizations (i.e., East Coast, Mid-West, Mountain and West Coast) that would be made up of representatives of the smaller regional organizations. This would serve two purposes. First, it would let "neighbors" get to know one another and at the same time provide a platform where problems common to all in that area could be worked on. On this level, lines of communication could be developed between the four regional organizations and an ongoing exchange of information vital to standardized national growth could be maintained, and then disseminated to the local organizations. Meetings of such area-wide organizations could be held in conjunction with a major

Next, a late night interview with WR6AJP's licensee, Jim Hendershot WA6VQP.

amateur convention within that geographic area, or better yet, by use of longer range communication on 75 SSB or whatever you please. Actually, regular on-the-air meetings would accomplish a lot more than one or two meetings eyeball each year, but these are just suggestions, and admittedly open for improvement. Anyhow, going one step further, that being to a national and possibly international level, I can foresee the top echelon being a modification of the now existing VHF Repeater Advisory Committee, i.e., a reorganization to a VHF Spectrum Utilization Advisory Committee. Rather than being appointed by ARRL HQ, this "top drawer" group would be composed of four or five "elected" members of each area-wide organization and would be assigned the task of dealing with *all* VHF/UHF problems that required handling on a national basis. In addition, since VHF operation is not isolated to the USA, I could see an open invitation being given to foreign representatives of VHF/UHF interest to sit in and exchange ideas with us. Similar to the way that the ARRL Board of Directors meet, this committee could hold similar meetings either quarterly, semi-annually or annually as necessity would dictate. Travel costs for such national meetings could be generated through shared funding on the part of each local organization or that in combination with partial funding from the delegates themselves.

Note the difference: From the "grass roots" local level on up, no one individual is appointed. On every level, those in positions of power are elected by their peers. There is no one individual anyplace with supreme power over anyone. Rather all decisions on each level are handled by majority vote resulting in, basically, a democratic republic for the VHF-oriented amateur – one with the possibility of developing worldwide ties. In this bicentennial year, not a bad goal to shoot for. As a "long-standing" League member of some two months now, I offer these suggestions to both them and you for consideration, in the hope that they may be of some true utility.

LOOKING WEST VISITS AN OPEN AUTOPATCH AND VICE VERSA

Ever been visited by a repeater? Believe it or not it has happened more than once around this QTH and I have the pictures to prove it. OK . . . to be honest only once did a complete repeater, along with the person that created it, pass by to spend an evening, that being about three months ago when Mark WA6DPB stopped over to show me a new creation for 420. Got some good color slides of that one and perhaps we can get a "cover" out of one of them in the future. Maybe . . . huh, Wayne?

Anyhow, it was a visit by Jim Hendershot WA6VQP, earlier this evening that has lead to the following. Jim, better known around here as "Jr," passed by to show me the new receiver that will soon serve as the "ears" of his two meter open autopatch repeater system WR6AJP – 146.865 in – 146.265 out. Jim's system is located here in the San Fernando Valley in an area known as Sylmar, basically the northeast corner of the Valley. AJP is one of the Inverted California Plan split-split systems that has proven that what was thought up out here really does work – an open autopatch on an inverted split-split that operates 24 hours a day without any adjacent channel problems. WR6AJP is one of two fully open autopatch systems serving the Los Angeles metropolitan area, the other being WR6ADH on 147.72 in – 147.12 out. There is a third autopatch system, WR6AKB in Palos Verdes (146.745/145), that also purports to be an open autopatch; however, its owner requires regular users of the autopatch facility to become "club members" and provide ongoing support for the "club." To my way of thinking, this latter stipulation takes WR6AKB out of the truly open autopatch category even though the repeater system itself is open access carrier squelch. By contrast, both ADH and AJP operate under the premise that voluntary user contribution must support their continued operations. While I have never spoken with Wayne Curley WA6NRB, owner of ADH, on this matter, the following from the June 16, 1975 SWAPS NEWSLETTER is a very sensible approach in my opinion.

"What is my fair share of the phone bill? The amount of the donation in support of the phone bill is based on how much a user uses it. Each minute the phone is in use is 6¢, whether he calls Whittier or Hewhall. Of course, there is the cost of the basic phone service, plus the coupler, etc., which is part of the phone bill also. With a totally open autopatch system, support is strictly voluntary. So just remember the more calls, the more time, the more money."

Note the phrase "strictly voluntary." Simply, if you are one of those stalwart souls that is providing your area with open autopatch service, technically, you are doing so "out of the goodness of your heart," and user support of your operating expenses is something really up to the whim of your users. However, when one decides that he will become a regular user of an open autopatch system, he takes on a very important moral obligation to show some form of support. No open autopatch can long survive unless those amateurs making use of its facilities give ongoing financial support. I personally look at any autopatch system as a friend doing me a favor by supplying me with an extension telephone in my car. If it were an extension of my own phone and I used it, I would have to pay the costs involved. Now if a friend were to put an extension of his phone in my home, and I were to make use of said phone, I would be morally obligated to pay my share of the bill. The guy providing you with an open autopatch is doing just that – giving you an extension telephone that you can make use of while mobile and the aforementioned moral obligation does indeed exist. The responsibility for defraying costs rests on the shoulders of all that partake. I would much prefer to see open autopatch repeaters prosper on the basis of voluntary user contribution rather than the road that WR6AKB has gone, since when an autopatch system is forced to form a "club type operation" to insure survival, and even if such a club is open to membership by any interested amateur as is the case with AKB, can it truly be said that such an autopatch repeater is an open autopatch? If the very concept of the open autopatch, a la the ADH and AJP type operation, is to survive this initial time period, it is up to those that make use of these systems, up to you.

I might be sticking my neck out a bit, but the aforementioned SWAPS NETWORK June '75 NEWSLETTER has a lot of good information about operating on an open autopatch repeater with some very good basic common sense ideas on this topic. Perhaps a note to them at PO Box "B," San Gabriel CA 91778 will bring you a copy if any are still available. If not, I will try and find space in future columns to print more of the SWAPS NETWORK's ideas on open autopatch repeater operation.

The story of WR6AJP itself is an interesting repeater story and it will be part of next month's Looking West, along with what took place at SAROC, and if space permits, a few other goodies. In the meantime, I hope that the pictures entice you enough to be back next month for the complete WR6AJP story. No, that photo of the machine itself is not a put-on. What is pictured is a fully operational two meter open autopatch that has never "been down" due to equipment failure! Who said the art of home brew is dead?

Tracking the HAMBURGLAR

STOLEN: RF Communications, Inc 2m FM rig, Model RF-403. Four channels. Crystalled for 16.76, .94, 148.01, 143.99. Noticeable "carbon mike" audio quality. Contact W3DTN.

TAKEN: IC-21 S/N 6047 also hi-lo police monitor suspects two male Negros, driving 1968 Ford Falcon dark green Ohio license 654283. Carl Scheff WB8LTN.

MADE OFF WITH: Regency HR-2, Heathkit linear attached S.S.N. 405-46-6000 inscribed on both units. John Fornash WB4TQH.

ABDUCTED: Regency HR-2-A S/N 040842. Earl Nichols W4PII.

SHANGHAIED: TR-22-C S/N 121124 on 9/3/75. Jack Moorhouse W8IHQ.

ROBBED: Clegg 27/B S/N 27014 3313, Tempo 220 S/N 5171, also Regency 440 no serial number available. Gorden Plainfield VE3HKE.

STOLEN: Icom 230 S/N 2403241; IC-3PA (Icom) power supply S/N 1105929; Drake TR-22C S/N 940898. These items were stolen as of 11-7-75. I would appreciate any information concerning these stolen items, as they were uninsured and a heavy loss. Please contact me, or Wilshire Division/Los Angeles Police Department. Michael Mockler, 121 S. Oxford Ave., Apt. E, Los Angeles CA 90004. Phone 213-388-6584.

FILCHED: Kenwood TS-520 S/N 231023; Icom IC-22 S/N 10718; KW107 supermatch tools, books, etc. Taken from my car in Toronto November 1975. Any information please contact Metropolitan Toronto police. James Knott VE3CVM.

PILFERED: KDK 144 – 10SX S/N 5446. Taken from my car in the Chicago area on 10-25-75. Nick Kalafice WØOZZ, 117 West Glencrest Drive, Mankato, Minnesota 56001. Phone 507-387-2279.

PLUNDERED: Drake TR-72, S/N 860589. Bob Armontrout WB8TNZ.

MISAPPROPRIATED: HR-212 S/N 24-00355. Don Tacy WA8UKS.

KIDNAPPED: Drake TR-22 S/N 430470 large mike conn., also mini phone jack. Bart Rosenberg WA8HKO.

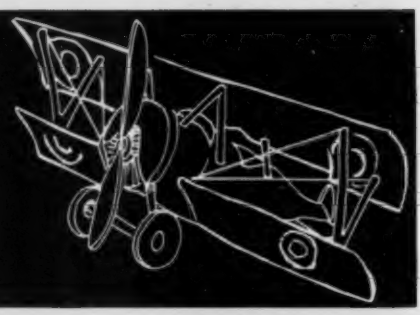
PILLAGED: Unimetrix Ultra Comm. S/N D90325, eight sets xtals. T.T. pad two separate phone jacks, mike had a piece broken on top. Ross Fox W8PZX.

RIFLED: Lafayette HA-146. T.T. pad, ball point marker on deviation pod, phone jack in rear, all CRA xtals plus. Jim Frey WA4LBI.

HIJACKED: Standard Mobile model 825-MA, S/N 205258 written on inside of chassis "K8UYQ" dent on backside lower left, T.T. pad "K8UYQ" on inside of box next to speaker jack. John Zisman WB8JWD.

RUSTLED: Unimetrix Ultra Comm no further info. Donn Nottage W8JGP.

Autobiography of an Ancient Aviator



W. Sanger Green
1379 E. 15 Street
Brooklyn NY 11230

EARLY AERONAUTICS BRANCH,
U.S. DEPARTMENT OF COMMERCE

In the early part of its organizational phase, the Aeronautics Branch of the Department of Commerce was very short of help. Applications for pilot, aircraft and mechanics licenses were pouring into the Washington office. They had the country divided into regions with a Supervising Inspector in charge of each. About all the Washington office was able to do with these hundreds of applications was separate them according to regions, then ship them out to the Supervising Inspector of each region. Since the District of Columbia was in my region, I would stop in at headquarters as often as necessary and pick up my new applications, sort them out and make up itineraries.

The pay on this job was something like $300 a month to start. You were provided with a book of government travel requests to take care of transportation. When you were away from your official headquarters you could collect $6 per diem to cover food and lodging, tips (not over 25¢), taxies, street cars, buses and local phone calls (not over 10¢) on an expense account. Don't you wish you had a shot at a deal like that?

My earlier trips were made by train and bus. One I remember quite well took Frank Jerdone and me to various places in North Carolina. We started at Raleigh and split up to cover two itineraries. Mine took me to Winston-Salem, Greensboro, North Wilksboro, Maxton, Hamlet and back to Raleigh. I arrived at North Wilksboro a little before noon. I had one applicant there for aircraft and pilot licenses whom I tried to reach by phone. No phone. So I went to the local police station, identified myself and asked if they could help me locate the fellow. They "hemmed and hawed" and said they would see what they could do. I told them I would be having lunch at the restaurant down the street and would appreciate any information they could get me. Well, while I was having lunch, a fellow came in and sat down at my table. He asked me why I wanted to get in touch with the applicant. I told him and showed him my ID card. "Oh," he said, "You're from the government up in Washington?" I said I was. Then he said "Well, the feller you wanted to see won't be available. There's a bus leaving for Winston-Salem in an hour and my advice to you is to be on that bus." I didn't argue with him. *I was on that bus.* The remainder of that trip took us to Rocky Mount and Norfolk Naval Air Station, where they gave us a lift over to Langley Field. After a weekend at Langley renewing old acquaintances and three working days at Richmond, we returned to home plate in Washington.

Since quite a few pilots at NAS Norfolk and Langley Field had expressed a desire to obtain a civilian pilot license, I got approval to spend a few days there checking pilots for transport pilot tickets. The Department assigned me a brand new J5 Laird for the trip. Now the Laird was a beautiful shiny ship, *but* it was an open cockpit job with no heater; the month was December and no winter flying clothes went with the machine. I had my own helmet and goggles so I bundled up as best I could in my business overcoat and set sail for Langley. The temperature on the ground at Bolling was about 45° so I flew low to Langley and didn't suffer too much. The trip back to Bolling a few days later was a different story. It was around 30° on the ground at Langley the morning of my departure for Bolling (Washington). As the trip progressed, I got colder, and the colder I got the more I leaned on the throttle, so I made the 130 mile trip in about an hour. That was unquestionably the coldest ride I ever had. They had to help me out of the ship at Bolling.

First thing I did upon my arrival at the "Deep de Com" hangar was to ask the man in charge to "scrounge" some winter flying gear for me. He said he thought he could help and this is how he did it. It seems that only a few days before, there had been a fairly extensive fire in one of the Bolling Field hangars. Now this is an event that every Supply Sergeant on the field welcomed, because it enabled him to claim that almost every item in his charge that had been lost, strayed or stolen was destroyed in that hangar fire. So all my man had to do was to get a winter flying suit, boots and gloves from a Supply Sergeant who would survey them as having been lost in the fire. I got my winter flying gear for a $10 bill. Since this was some 48 years ago, I guess that the statute of limitations will cover all participants.

As of March 1, 1928, my official headquarters were changed from Washington to Philadelphia. They also issued me a J5 Travelair. I was glad to swap the Laird for the Travelair. The Laird was a much better looking plane and it was faster, but the Travelair was much better for getting in and out of small fields -- particularly the many where you had to land up hill and take off down hill.

After four months of operating out of Washington as a temporary headquarters, I was pleased to get the permanent assignment to Philadelphia. First thing I did was to rent a small apartment and move Wayne and my wife, Cleo, to Philadelphia.

The Ludington Philadelphia Flying Service operated the municipal flying field just south of the city. Bob Hewitt, an old friend, was the manager. They did a lot of flying instruction, passenger hopping, cross country work and had an excellent service and repair shop. Bob was kind enough to provide me with a small room for a field office, complete with a desk, chairs, etc. Everyone was happy.

Next month more about the rest of my time with the "Deep de Com" at Philadelphia and a first class hunting trip.

LOOTED: Heath HW-202, series 01324. Setup for 34/94, 31/91, 22/82, 16/76, 28/88, 38/98. Stolen January 1, 1976. Also taken: a first aid kit for volunteer rescue squad. Info to Blacksburg Police Dept. Blacksburg VA 24060, telephone (703) 552-2311. Douglas Hall WA4UNS/P4

ROBBED: Drake TR-22C, S/N 850265. Taken in San Diego. Reward offered. David M. Anderson WA6KHH/6, PO Box 1097, Lemoore CA 93245.

KIDNAPPED: Robyn GT VII B 5001-005801. Stolen September 21, 1975. Mark Jacobson, 2133 Riverwood, Okemos MI 48864.

SHANGHAIED: Courier Traveller II, S/N 12Y21737. Taken from my car in Tamaqua PA on 10/22/75. R. A. Hutton, Box 197, Schnecksville PA 18078.

MADE OFF WITH: IC-230 S/N 240 1926, Heathkit HWA-202-6 colinear, and Data Tone 2 touch tone encoder that was stolen from my car in Tampa FL on October 31, 1975. Report filed with Hillsborough County Sheriff Dept. Bud Holman WA4ASJ, PO Box 698, Vero Beach FL 32960.

ABDUCTED: Drake ML-2 S/N 11603, 17 crystals, coax line from mike input to jack on rear of case. William B. Tilghman, 448 W. Oak Ridge, Apt 201, Orlando FL 32809.

SWIPED: Lafayette HA-146 nine sets xtals. no mike, 115.70 installed in priority position. Lou Rauh WB8WBD.

MISAPPROPRIATED: KDK 144-10SX S/N 5446. Taken from my car in the Chicago area on 10-25-75. Nick Kalafice WØOZZ, 117 West Glencrest Drive, Mankato MN 56001. 507-387-2279.

SNATCHED: Drake TR-22 six channel S/N 610017 I.D. perm. G.E. nameplate attached, has CRA repeater xtals plus 46 simplex and also 66/06. Roger Jollis WB8HUP.

TAKEN: Drake TR-22-C, S/N 810233, broken antenna, trimline T.T. Pad attached all CRA Xtals plus. Steve Coulson WB8QOG.

PILLAGED: Midland 13-505, S/N 030647. Len Malone WB8PTP.

RIFLED: Drake TR-22-C, S/N 851327, large ac plug red power cord, matching net, included for synthesizer in unit. Dr. Ed Casey W8DWJ.

HIJACKED: 12 channel Midland Mobile, no further info. Mike Moore WA8ZPY.

RUSTLED: Heathkit HW202 series 00316 stolen from Newport Shopping Center. Warren Peterson WB4VRJ.

SWIPED: Regency HR-2-B S/N 49/03875, also HR-2-A amp. S/N 11502346. Bill Mell WB4KQB.

BURGLED: One E. F. Johnson Msgr III "CB" transceiver, converted for use on business band, containing crystals for 27.41 and 27.43 mcs. (also some CB channels), S/N 143C080-69008. Also has my name and social security no. "Harold Dalton, 247-56-8723" engraved inside radio. Taken from my car in Greenville SC 12-13-75. Harold Dalton WN4JQR/KWD593, Rte. 5-Box 83A, Pickens SC 29671.

LIFTED: Standard 826 MA, S/N 208185 was stolen from my car October 31 while it was parked in the parking lot of Dow Radio in Pasadena, California. Contact Gary Jaegers WB6WDV, 870 E. Alameda St., Altadena, California or the Pasadena, California police department.

be my guest

visiting views from around the world

Chalk It Up As A Lesson

"Hey honkie, whatcha doin' down here?" is not an uncommon phrase heard in the neighborhood where Mike (WB6ZHD) and I found ourselves. We were there to supposedly "help" a newcomer on WR6ACS get his new rig more on frequency. Since he had given his call as KL84368 or some such, it isn't too difficult to figure out why we placed ourselves in this neighborhood late one afternoon. We had a San Francisco policeman with us.

This story has an unfortunate ending for some unlucky ham somewhere that has had his IC-230 ripped off. Of course, the metalized sticker containing the serial number was merely peeled off. Why doesn't some ham club start a project to encourage manufacturers to *engrave* serial numbers on the chassis or some other hard-to-replace part? But more important, why don't all hams engrave their driver's license and the two letters signifying their state on every easily saleable item in their home???? According to several police departments, the driver's license is much easier to trace than your callsign. It takes approximately 15 seconds to trace any driver's license if you indicate the state. It might take weeks to trace an owner by his call letters. Quite often the well-known callbook is outdated by the time it gets into print, and, believe it or not, a lot of policemen never heard of the callbook.

I personally removed both covers of this IC-230 looking for some kind of ID. There was none. The policeman called in a description of the rig – they had nothing on it. Of course not!!! If it is originally stolen by a "professional" thief, he certainly transports it out of the area before he sells it. So there was nothing we or the police could do in this episode except congratulate the owner on making a good buy (at $150.00) and advising him of the illegality of operating without an amateur license.

You don't have to conceal your engraving; in fact, it is better if it is very obvious – on the cover, front panel, or chrome frame – the thief then has more difficulty in disposing of it. It *DOES NOT* make the rig less valuable if you decide to sell or trade it. Just give the purchaser a "bill of sale" or a note. Then, if it is stolen later, the police would of course contact you, and you would be able to steer them on to the next owner. Even if it has gone legally through several owners, if each passed on a bill of sale with it, it could still be traced to the final owner easily, and believe me, the police would do this bird-dogging gladly when they suspect they have a thief. It may be their best evidence.

Think about it – the price of an engraving tool is a hell of a lot less than insurance, and quite often more apt to get your equipment back. Don't overlook engraving your TV, your tape recorder, your sewing machine, typewriter, etc.

The lucky new owner of that IC-230 is a legitimate CBer, and thought he was buying a CB rig. Now I do *NOT* want to hear descriptions of all of the stolen IC-230s across the country. Just chalk it up as a lesson to engrave your driver's license and state on your next one.

Dick Altman WA6AXV
San Francisco CA

Let's Grow Up

Reprinted from The Canadian Amateur.

Are we mature enough to run our own show or do we always have to be told what to do?

For many years now, in fact far longer than most of us can remember, the lower amateur bands have by regulation (law) been subdivided into "CW" and "phone" segments. Initially this was done to provide "guard" bands to protect services on adjacent frequencies from phone sidebands and splatter. But now the bands have been officially divided up between CW and phone mainly because of the inability of amateurs themselves to sort out and amicably resolve their own problems.

Why is it that in Canada (and the U.S.) it is necessary to have *laws* that tell us what we can and cannot do within our allocated frequency bands? Amateurs in other countries seem to be able to carry on successfully without the need for such official intervention. Surely our amateur fraternity has now reached the age of self-determination and no longer needs to be *told* what or what not to do. Why should the DOC have to expend many man-years of work (and thousands of dollars) in an attempt to solve an unresolvable problem? They never will be able to satisfy everyone. We can do the job just as well (or maybe better) ourselves.

It is my firm belief that CW and phone sub-allocations (except for band-edge guard bands where necessary) should not be made part of official legislation. If we are not mature enough to sort this problem out among ourselves perhaps we should not be enjoying the hobby. If we carry on in our present regimented fashion, CW may soon be prohibited in certain segments of the bands, and there will be sub-bands for SSB, USB, LSB, RTTY, television, etc.

So what if there is some interference between CW and phone operations – is it all that terrible? It may even improve our operating techniques and capabilities.

Such an "open" band concept does not in any way affect the incentive concept since phone and other privileges would still be allocated according to the qualifications (class of radio operator's certificates) and experience of the licensee.

Legislatively this can be easily accomplished by simplifying the list of amateur frequency bands in the (Canadian DOC) General Radio Regulation, Part II, to show only the complete amateur bands and by deleting Schedules II through V. When an operator becomes appropriately qualified, he would be authorized to operate phone on any one or more of the applicable high frequency bands without reference to any specific segment of the bands.

These are strictly the opinions of the writer, who has listened to the pros and cons of this so often vociferously argued subject for these many years, as well as having been involved, from the official side, in trying to find an acceptable solution to the multitudinous "demands" of groups and individuals within the fraternity.

Let's grow up and do the job ourselves as responsible and reasonable individuals.

A.P. Stark VE3ZS
22 Lyall St.
Ottawa, Ontario
CANADA

Art is a retired DOC senior official. – Ed.

With Hy-Gain's 273 2-meter J-pole all you pay for is performance.

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lousy
bunch of rocks
you ignored my comments in
I insist that you print ev

LETTERS

THE MAILMAN DIDN'T RECOGNIZE IT

What kind of a nut are you? I mean really you *must* be one to be against one of the best changes in format that you could possibly have made! I can now see the damn printing for a change!

This January issue is really great and I cannot fathom your having such a hang-up on going to the larger size. More room for bigger and better schematics, layouts, pictures and above all easier to read. Best move you could have made!

This issue has a lot in it, too. I am going to build the automatic dialer or something similar to it. I really enjoyed that article. Of the other many fine articles, one worthy of special mention, at least for me, is the one on "Module Kits – a Low Cost Homebrewing Breakthrough." I was interested in this article because it is what I have been engaged in for several months, but I am not as far along as G.R. and Bob. I haven't gotten to the packaging stage, yet, just the kits.

I just wanted to write and encourage you in the new magazine format. There are always some nuts who are against "everything" new, but I'll wager a donut that the great majority of your readers will be enthusiastic about the larger size!

Lon Allbright W6SLF
San Diego CA

Nice work! Your new format for *73* is F.B. Really like it.

F. Tuttle W8QLL
Midland MI

Got my giant issue today and those advantages you wanted are showing up. The mailman, who delivers my mail next door (he can't read), didn't recognize it: It arrived in perfect condition, for once. I don't know how long he'll be fooled! I found that it swats flies better than last year's model, does better no-nos on the kiddies, and makes great placemats.

Don't be too upset over the size; XYL says that quality not size is important (that's what she tells me). Some will like it; some will learn to like it.

Richard Fosburgh WN5PWE
Dayton TX

I received my January 76 issue of *73* and was pleasantly surprised at how easy the new size of type is to read. Please count me as one in favor of the new size, even though it will require new bookshelves for the shack.

Peter K. Von Hagen WA6HXM
Palos Verdes Pen CA

I just received my January issue of *73* and want to congratulate you and your staff on an outstanding job in making the transition to the enlarged format. With a background in journalism, I can appreciate some of the problems you must have had in making layout changes.

I had every expectation that *73* would continue to be a quality periodical, and it appears that I haven't been disappointed.

Dan Davis K3DSQ/4
Langley AFB VA

I like it! I like it! I like it! The new size. The articles. The projects! I even sent for QSLs and a new callbook from this issue.

Good before . . . greater now. Keep on . . . keeping on!

Don Dye KØJVE
University Park IA

I didn't think you could do it, but you did. You actually topped the November 1972 issue with the January 1976 issue. This has got to be the greatest issue of any amateur magazine in history.

There is no way of telling what the reaction will be to the new format, but for what it's worth, I like it. For one thing, the drawings seem to be quite a bit larger, and the older I get the more I appreciate things like that.

For another, the magazine seems to lie flat and open easier. This is reminiscent of the saddle binding you used years ago when you first started *73*.

I must admit I was a bit upset when the Nov/Dec 1975 issue arrived, but I understand the problem now, and this fantastic January issue more than makes up for it.

Bill Gulledge K5UAR
Downsville LA

Just got the January 76 issue. New format looks great!!

Glenn R. Kurzenknabe K3SWZ
New Cumberland PA

Your January 1976 issue is the best ever in the 13 years I have been a subscriber.

Harry Roblyer WØDLM
Burwell NE

I love the new format. Only one comment: Move the printing over toward the edge of the page. It would make it easier to read with one hand folded over. What ever happened to GRRREEEN? About time it came back I think.

Ron Vealik WA6LTH
Crestline CA

TREATED

I have recently treated myself to a 3 year subscription to your magazine after "sampling" it from the local newsstands for some months. *73* is a magazine in a class by itself. It is really great to be able to get hold of such a varied collection of "matter" every month. Your magazine has truly got something for everyone and really doesn't waste the volumes of paper that certain other ham radio publications do on useless chitchat. I especially appreciated the various articles on weather satellite receiving station construction by WB8DQT. I am now planning the construction of my own station using some of his circuitry and some of my own. I would like to suggest that WB8DQT consider publishing a book on the topic in the same way he worked on the SSTV handbook.

John L. Webster VP2DN
St. Augustine
Trinidad, W.I.

WB8DQT's new Weather Satellite Handbook *should be on the 73 presses right now. – Ed.*

SMELL NICE, TOO

Maybe all of the people who've built the SD Sales Clock Kit wonder, as did I, about what the devil you can house the clock in really fast and easy. Here's my idea, and it costs just about nothing.

Have someone give you either after shave lotion or all-purpose(?) lotion put out by English Leather in the eight ounce size. The cardboard box (which used to be real wood) is perfect for the SD circuit boards. The front cutout needed is almost exactly ½ by 2½ inches, and the whole job can be done with an X-Acto knife. No LED mask is needed: Just let the six displays poke right through the hole you've cut in the side of the box. If you cut the box right, you won't even have to fasten down the circuit boards; they'll fit nicely with friction between them and the cardboard.

I know that the clock case people will hate this idea, but why spend money when you can have a nifty case and smell nice, too?

Tom Donohoe W2NJS/WA1PXV
New York NY

GETTING OUT WHAT YOU PUT IN

Just had to pass along some "observations" regarding "Getting Out" in the January issue.

I firmly believe that Mr. Lichtgarn is a "quitter."

I was just around the 40 year old mark when I became interested in ham radio and, of course, it's hard to "teach an old dog new tricks." My line of work is about as remote from electronics as auto racing and ice hockey, so had to enter an entirely new and rather frightening world.

With the aid of a friend, VE1AMZ Clive Bagley, I was able to pass not only the "Experimental" but also the "Advanced" ticket. For those not familiar with Canadian rules, the code is 10 wpm for the "Experimental" and 15 wpm for the "Advanced." I can truthfully say that it was not easy for me and took a great deal of time and effort on my part. Now that it's over and behind me, I can sympathize with others having a rough time, but not quitting. I think the old adage of "you will only get out of something exactly what you put into it" would apply in this case.

I often remark to others that if my XYL, VE1BEV, can pass the exam, anyone can.

Hope I made my point clear without making it sound like I'm blowing my own horn.

Thanks, Wayne, and I like the new format!!

Ralph F. Campbell VE1QU
Dartmouth N.S.

I agree with your answer to Fred Lichtgarn. Anyone that doesn't have the patience to learn the code doesn't belong on a ham band. About your magazine – I'm glad it's around. It's what originally got me interested in amateur radio, and has kept me interested and working on my Novice license. I've already passed the code; the theory comes in 3 weeks. I hope to move to General in 6-8 months after getting on the air. Again, thanks *73*, for being around!

Jim Bay
Columbus OH

FAR AND AWAY THE BEST

Thought you might be interested in hearing the results of my letter about XU4XA that appeared in the Nov/Dec issue of *73*.

First off, I received several nice letters, but wonder of wonders, W8JTW (now WA2BRI) sent me a Xerox copy of one of my XU4XA cards and an original! He had two – I worked him when he was in Columbus, Ohio in 1939.

Then later, W3HTG, now W6HTG, and current chief operator at KPH, paid me a personal visit, and *he* brought me another XU4XA card, as he had two! He was in Atlantic City, N.J. when we were QSO.

W3LTH wrote and says old W8CRA, now W3CRA, is still hale and hearty and going strong in Pennsylvania. Also had a note from Ed Hopper W2GT – he is still quite active.

Now – if I could get a Xerox copy – or better yet – an original of my old XU8LR and XU8XA cards when I was operating in Shanghai, I'd really be pleased!

I still think *73* is far and away the best magazine published in the ham field, Wayne – I like the new and bigger size also.

Keep up the fine work, and I assure you I'll continue as a subscriber as long as I'm around.

Al Lower W6CLB
ex-XU4XA, XU8LR,
XU8XA, etc., etc.
3916 Arden Way
Sacramento CA 95825

BURNED OUT

I have a cathode ray oscilloscope model 670, made by Hickok, and the power transformer has burned out. I would like to be put in touch with someone to wind the power transformer for me, as I cannot obtain one from Hickok. I have the engineering drawing from Hickok with the power windings listed. I would appreciate it if you can help me.

Walter Schivo
560 Eldridge Avenue
Novato CA 94947
415-897-4088

TWO HANDS NOW

The magazine in the new format arrived and the setup looks quite attractive. The only complaint I have would be that it now takes two hands instead of one to hold it up so if one wants to scratch his ear while perusing the periodical, he has to lose his place.

Regarding 2 meter cooperation and band plans and all, in some cases the high officials making the decisions are also high officials in repeaters and there has been some criticism that one will feather his own nest rather than make objective decisions for the benefit of the general public. I note one of the "private repeater" people is on the ARRL Committee.

Paul Schuett WA6CPP/WA7PEI
Wallace CA

WATCH OUT SOUTHERNERS!

I wanted to comment on the Looking West column that Bill Pasternak writes for your thick magazine. I don't know if Bill is a new guy or an old timer in Southern California, but the problems the 2 meter repeater councils in the North and South are having goes way back before repeaters. In fact, it has nothing to do with Ham Radio at all but is purely geographical in nature.

Here is the true problem – it seems that there is a Northern California and a Southern California. And for years the two factions have been fighting over almost everything from politics to tax dollars and water rights. For instance, it appears that when a Governor is elected he usually gets most of his votes by whether he resides in Southern or Northern California – not by whether he is a Democrat or a Republican.

So Bill, don't take it so hard. We Northern Californians have been trying to secede from Southern California for many years. We have all this beautiful country, forests, water, blue skies (smog-free), fairly unpolluted beaches, water, the Golden Gate Bridge, fewer people, water and freeways that actually move at rush hour. And Southern California – well as far as we've been able to determine up here, their biggest assets are smog, people, deserts, and Ronald Reagan the actor.

The Northerners had hoped that the earthquake they had in the South would do the inevitable – make Southern California break off and float out to sea. But since that idea didn't work, tell ya what we're agonna do. Let's go ahead and make it two states like we planned to anyway. Then you guys down there can take Jerry Brown and we'll elect a Northerner for Governor. Or we'll keep Jerry Brown and you folks can elect a new Governor. I heard on the wireless the other day that Richard Nixon is a citizen of your new state. Perhaps him!

Now, you ask, how will we make out financially when Southern California is so rich? That's easy – we sell water to the South and become rich like the sheiks in the Mideast with their oil wells. Watch out Southerners! It gets awful dry down there.

Bill, we can hear you shaking in your boots down there but please don't worry – it sounds great to us. And what of the future of Northern California? Well – today a new state – tomorrow a new country. That way we can ask for foreign aid from the rich Americans. We could also have our own version of the FCC – terrific!

As for working out the problems with repeaters – perhaps you'd like to make an appointment with our ambassador. He will be glad to send you several crates of red tape and forms in 32 parts to fill out. The North shall rise again – but don't worry Bill!!!!

Robert Lee Fields
Box 884
El Sobrante
Northern California 94803

RELIABLE SOURCE

Just a note to let *73*'s readers know how pleased I am with one of your advertisers. Dealing with Communications Specialists, manufacturers of the ME-3 miniature PL encoder, has been nothing less than a pleasure. Their products are excellent and delivery is usually less than five days cross-country.

Reliable sources are hard to find. Thanks.

Charles B. Anzman WB2PVH/WR2AIL
Freeport NY

SHOT DOWN AGAIN

In the interest of fair play and downright revenge, I am writing and documenting the below information concerning unethical business practices on the part of one of your former advertisers in the hopes that others will be spared the frustration, mental anguish and expense I have gone through.

On 14 March 1975, I placed an order with Trigger Electronics of River Forest, Illinois for a Drake low pass rf filter. Being a patient person, I waited expectedly until July for my filter. When it did not arrive as expected, I wrote Trigger Electronics and requested to know the disposition of my order and an immediate refund if the merchandise had not already been shipped.

In reply, Trigger stated that the product had been out of stock and that I could expect shipment within two weeks. No mention was made of my desire for a refund, and in fact this was the first indication that my order had even been received in the first place.

When the filter had not arrived by September, some .two months after the purported shipment date, I again wrote and demanded an immediate rebate of my purchase price and in turn was advised that I would have to provide additional information so that they might locate the "paper work." I had already provided them with copies of all previous correspondence which remained in my possession.

When I again wrote in October and threatened legal action, I was advised that I could expect them to carry out my wishes once they had completed researching their files. I have heard nothing since then.

I brought this matter to the attention of other local hams in this area via the 2 meter repeater and was appalled at what I heard. Numerous hams in this area have been the recipients of equally poor service by Trigger Electronics, service which is unethical, non-existent, and in my estimation, outright mail fraud. All, other than myself, have resigned themselves to the fact that they have been taken and forfeited their hard earned green, some losing money in the three figure range.

This type of operation must not be allowed to continue and I am sincerely seeking your attention in exposing this shoddy operation to amateurs nationwide via *73 Magazine*.

Raymond E. Ault WA6EVX/KG6
FPO San Francisco CA

ELEVEN METER FREAK?

In response to the recent letter submitted by Scott Liebling WA3OXG of Pittsburg PA, thank you Scott for your letter regarding CBers.

Yes, we are people just like you are! I resent being called an 11 meter freak and the constant nit-picking in the ham magazines concerning "people" who use CB.

I will even give you "hams" the pleasure of seeing in black and white these words from a CBer:

"In my opinion, as many as 85% of the people who key their over modulated D104 mikes belong in juvenile homes."

There once was a time when I too was engaged in chitchat, arguing with the channel "landlord" that I too had a right to use "his" channel, etc.

The time does come, though, after countless letters, calls, etc., to the FCC, that one realizes that it's useless to even bother.

I feel, Scott, that many people now might go the way of the "ham" if they were not to be embarrassed for ever being a CBer.

I recall listening in one evening on a 2 meter FM when a new "ham" was really getting a going over as he was once a CBer. He was being called his former "handle" of "Yogi Bear," etc.

I am no longer active in CB although I still have all my equipment and intend to use it again some day, if things ever straighten out on the CB band.

What I would like to say, though, is something about the good CBers I've known and become involved with.

I've personally seen and been part of thousands of CBers who searched for 8 days under the most horrifying conditions for a lost child, assisted police and fire depts. on Halloween, walking and bike marathons. I've seen CBers donate hundreds of quarts of blood, collect thousands of dollars for a truck driver who was badly hurt, hold benefit coffee breaks for burned out families, dying children, etc.

Assist the Coast Guard with missing boats when people were foolish enough to go too far and depend on a

CB radio, report accidents, render first aid on the scene – and I could go on and on.

Believe me when I say we would love to weed out the bad apples, but there are also some very fine people. Please don't forget them, for they might want to become one of you, if you'll let them.

I'd also like to mention in this letter the Newport County Radio Club to which my son belongs. Bob is now WN1VWN thanks to the fine "hams" who patiently encouraged my son and held his interest by letting him become part of their activities while learning.

A special thanks to Fred Evans W1JFF, for all he's done for Bob, things too numerous to mention.

June Vlasaty KHV-1421
Newport RI

MORE ON ETCHING

I just finished reading the article by John Harrington, "You Can Make Photo PC Boards" (Feb 76). I found it to be a good article. Having also done some work with PC boards, I thought I might offer some of my own findings to supplement the article. When working with the photo sensitizing spray, I found it advisable to do it in a well-ventilated room. Wear one of those sterile masks that painters use to cover their mouths and noses. You can find them in just about any paint or hardware store.

Another type of etchant that I found very nice and neat to use is ammonium persulphate. Sold by Kepro (EPI-G), it comes in a crystalline powder form and is mixed with water when ready to be used. The advantage of this stuff over ferric chloride is that it's clear and not as messy to handle. You can see the progress of the board as it is being etched. It's also fast when heated to the recommended temperature.

If you use the G. C. Electronics sensitizing spray, don't use the Kepro developer. Some thing holds true if you buy the Kepro pre-sensitized board and try to develop it in the G. C. Developer. One way nothing will happen and the other way . . . well . . . it's back to the drawing board or should I say exposure board. In any case, don't mix brands in these two stages. There is no problem which I encountered in the etching stage. Use whatever brand you want.

One more thing: Above all, remember – whatever stuff you use, always read the warnings and the instructions and never lose respect for the chemicals you are using.

Isaac Michalowski WN2ALK
Brooklyn NY

When etching printed circuit boards with ferric chloride, it helps to warm the solution. This will reduce the etching time from about one hour to 15 minutes for small boards. Some use a heat lamp or oven, but these methods generate a lot of heat. If you use a plastic container and don't watch, it could be possible to melt the plastic.

If you have a microwave oven, that works fine. Thirty seconds or less is all that is necessary. No unnecessary heat is generated with this method. I use a glass jar with a plastic lid for small boards. Bigger boards could be done in an open tray.

A note of caution. The ferric chloride fumes might do bad things to the microwave oven so try to use a container that has some type of cover.

Max Holland W4MEA
Madisonville TN

SOME CHRISTMAS

I have bad news. I will be "off the air" temporarily. On Dec. 20, 1975 some PUNKS stole my *entire* communications equipment, and some TV test equipment, out of my garage. Here is the list: 1–Tempo FMH H. T. w/acces.; 1–HR-2 w/touchtone; 1–SX-100 & spkr; 1–Seneca 6&2; 1–Lafayette 6m xcvr; 1–Uticom 2m xcvr; 1–PCL nuvistor amp; 2–6&2m "CW" conv.; 1–swr meter; 1–12V. 4A. DC supply; 1–Sencore MU-150 tube checker/analyzer; 1–Sencore CRT checker/rejuvenator; 2–Tube caddies full of late type TV tubes; 3–Port. B&W TVs.

Loss is estimated at approximately $2,400. Some Christmas.

Anthony E. Bodo WA9YOZ
4380 Hayes St.
Gary IN 46408

KNOW YOUR NEIGHBORS

I recently had the pleasure of attending the first organizational meeting of the new Tri-State Repeater Council. This council, serving Metropolitan New York, New Jersey and Southern Connecticut, has been formed to finish the job that the now-defunct Northeast Repeater Association started. Under the very able direction of Dave Minott WA2EXP (Trustee WR2ACD, NY City), this group is attempting to clean up FM in New York and the surrounding areas and keep it that way. The key to achieving this goal is participation. The first meeting was attended by over one hundred local repeater trustees, an excellent representation, but many were not there. I urge all repeater groups, coordinated or not, to participate in this valiant effort by contacting Dave or one of the directors. The vibrations at the meeting were excellent and I feel that if ALL repeater groups are represented at the coming meetings, the TRC will work. Duke Harrison K2QPF has been retained as area frequency coordinator. Call him if you are planning a machine – it can only benefit you by coordinating.

On the same note, I have a very simple recommendation. If you are a repeater trustee and have other machines on "your" channel or 15 kHz next door, call the trustee of the other machines and say hello. At the Rochester ham convention, I ran into Tom Palmeiri WA2WKP who is trustee of the 175-775 repeater in White Plains NY. As trustee of WR2AIL here on Long Island (also 775) I made an immediate effort to say hello to Tom and develop a neighbor relationship. Now that both repeaters are COR, 24 hours a day, and constantly expanding coverage, Tom and I have avoided many problems by calling each other once in a while and letting each other know what's happening on the other end. In the near future we plan to link the two machines duplex via UHF and many other cooperative efforts are in the works. The moral is: Get to know your frequency neighbors – it couldn't hurt!

Keep up the good work reflecting FM activities in *73*. Love the new format.

Charlie Anzman WB2PVH/WA2AAB
President South Is. Rptr. Soc.
Freeport NY

ONLY LINK

Congratulations on doing it again!! Every time I think I have the "ultimate" in a two meter station, you publish another article which forces me to dig out the tools and commence to mess up the room, much to the chagrin of my long suffering first Sergeant.

At present, I am referring to the article by WA8LEM in the September issue on page 137, entitled "Adapting Telephone Handsets to FM Transceivers."

This is very easy to accomplish on the ITC Multi-2000 transceiver. A careful study of the tiny schematic revealed that pins 1 and 4 on the microphone plug are connected to ground. All that was necessary was to remove all connections from one of these pins (I used pin 1), and reconnect them to either the other pin or direct to ground. A single wire was then run from the external speaker jack on the rear panel to the vacant pin. I elected to use a hook-up which gave audio to the handset at all times, regardless of whether an external speaker was used or not.

I went the whole route with this modification and built a complete "remote" audio system in an old telephone case. If you know of anyone who might be interested, I will be more than happy to pass along the schematics and such on the external system. It definitely makes for more convenient operation and is quieter. The latter is an important item with me as I live in a barracks.

I would also like to correspond with other Multi-2000 owners and exchange ideas and problems. At present, I have a small (2 kHz) problem with my VXO. A frequency meter indicates that the output frequency is 2 kHz lower than the VXO knob indicates. I am also in need of another copy of the schematic to convert the 2000 to selectable sideband. The copy I had was misplaced (lost) in a big room shuffle in the barracks.

Many thanks for your help, both past and present, and keep up the good work with the magazine. It is about my only link with the fast changing hobby up here on this remote site.

Carl Hattan KØBZV/KL7
1931-07 Comm Det Box 75
APO Seattle 98711

DESIROUS

I am in definite desire to repair a Hallicrafters Receiver, Model S-40B, into working condition for monitoring both amateur and broadcast (HF) traffic. I have a copy of the schematic and an idea where the alteration was made by the previous owner. I am very desirous to have this unit back in condition in as short a time as possible.

I am also in the process of attempting to obtain a General Class Ticket!!

Ralph Brigham
405 Oxford Drive S.E.
Huntsville AL 35802
(205)-881-8400
after 4:00 pm

DIGITALITIS

Let's keep up the technical articles and "build it" articles in *73*.

With the new (UGH) size I expect to see PC board layouts!

I use a Mamiya 500 DTL with Litho film to copy the layout and then enlarge it onto 5x7 Litho film – does a good job with G-C photo resist spray.

I have contracted "Digitalitis" from your rags.

Mel Hart WØIBZ
St. Louis MO

WANTED: K6DGX

A lot has happened since you published my letter in the November/December issue.

On 24 December I passed the Advanced Class test, and now I'm anxiously undergoing the weeks-long wait for my ticket.

I found the *73* code tapes very helpful in preparing for the test. I'd like to pass along a hint for others – I started with the 6 wpm tape, since I already knew the code, having once had a Technician license. When I was copying the tape pretty well, I wondered how to get over the hump

Continued on page 112

HERE ARE **THE BUYS** FROM GENAVE

MADE IN USA

GTX-100

1¼-Meter FM
100 Channel Combinations—12 watts

Separate controls for independent transmit and receive frequency selection . . . Pre-selected paired frequency lock allows one knob operation . . . Backlighted.

Down from $199.95 **$149.95**
(Incl. 223.5 MHz)

GTX-600

6-Meter FM
100 Channel Combinations—35 watts

Separate controls for independent transmit and receive frequency selection . . . Pre-selected paired frequency lock allows one knob operation . . . Rear panel external speaker jack . . . Optional mic gain control and sub-audible tone mod possible.

Down from $199.95 **$149.95**
(Incl. 52.525 MHz)

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NOW . . . GENAVE STOCKS MOST
COMMON 2-M CRYSTALS
FOR IMMEDIATE DELIVERY

These crystals can be used in most makes that employ the following circuitry:

Transmit:
12 times for use in 32 pf capacitance circuits
Receive:
3 times for 10.7 MHz IF in 32 pf capacitance circuits (low side)

☐ **GTX-200-T**
2-meter FM, 100 channel combinations, 30 watts with factory installed tone encoder (Incl. 146.94 MHz)

$249.95

☐ **GTX-200**
2-meter FM, 100 channel combinations, 30 watts (Incl. 146.94 MHz)

$199.95

☐ **GTX-100**
1-¼ meter FM, 100 channel combinations, 12 watts (Incl. 223.5 MHz)

$149.95

☐ **GTX-10-S**
2-meter FM, 10 channels, 10 watts (Xtals not included)

$139.95

☐ **GTX-2**
2-meter FM, 10 channels, 30 watts with pushbutton frequency selector (Incl. 146.94 MHz)

$189.95

☐ **GTX-600**
6-meter FM, 100 channel combinations, 35 watts (Incl. 52.525 MHz)

$149.95

☐ **GTX-I**
2-meter FM, 6-channel, 3.5 watts Hand-Held
$249.95 (Bat. not incl.)

☐ **GTX-IT**
Same as GTX-1, plus Factory Installed Tone Encoder
Operate Auto Patch
$299.95 (Bat. not incl.)

☐ **Ringo Ranger ARX-2 6 db 2-M Base Antenna** @ $29.95 $_____

☐ **Lambda/4 2-M and 6-M Trunk Antenna** @ $29.95 $_____

☐ **TE-I Tone Encoder Pad** for plug-in installation on most amateur transceivers @ $59.95 $_____

☐ **TE-II Tone Encoder Pad** for installation on most Hand-Helds @ $49.95 $_____

☐ **PS-1 AC Power Supply** for use with all makes of transceivers 14 VDC-6 amps @ $69.95 $_____

and the following **standard** crystals @ $4.50 each $_____
Non-standard crystals @ $6.50 each: ..... $_____

For factory crystal installation add 8.50 per transceiver.

ACCESSORIES FOR GTX-1 and GTX-1T

☐ **PSI-18** Optional Nicad battery pack $29.95 $_____
☐ **PS-2** Charger for GTX-1(T) battery pack $39.95 $_____
☐ **GLC-1** Leather carrying case .....$12.95 $_____
☐ **TE-III** Tone Encoder (for use with GTX-1) $49.95 $_____

Genave

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20 % Down Payment Enclosed. Charge Balance To:
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CONTESTS

Editor:
Robert Baker WA1SCX
34 White Pine Drive
Littleton MA 01460

SAN JOSE BICENTENNIAL AWARD

The Santa Clara County Amateur Radio Association (SCCARA) is offering a special Bicentennial Award to celebrate the bicentennial of San Jose CA. The award is earned by working a number of SCCARA members, and stations located in San Jose, Santa Clara County, or the Pacific Division for a total of 200 points. The points are based on the location of the station requesting the award. A minimum number of SCCARA members must be included. Also, *one* contact with either of the club stations W6UW or W6UU may be counted for special point value. Contacts may be made on any mode, on any band, but each station can be counted only once regardless of bands or modes used. No credit will be allowed for contacts made via repeaters, except that OSCAR contacts will be counted. An endorsement for all phone or all CW contacts will be available if requested (and log data verifies). Contacts to be counted must be made between July 1, 1976 and December 31, 1977. To request the award, send log data (call of station worked, date, time, mode and handle of operator) along with $1.00 US or 5 IRCs (latest type only!) to the Club Secretary, SCCARA, PO Box 6, San Jose CA 95103.

The following table indicates QSO point values and minimum number of SCCARA members that must be included (only one contact with W6UU or W6UW is allowed, not both!):

	W/in SC Cnty	W/in 6th Dist. (Not SC Cnty)	W/out 6th Dist.
Min # SCCARA members	10	5	2
Pts/SCCARA member QSO	5	10	25
Pts for Club Stat QSO (only 1)	10	20	50
Pts for other SC County Contacts (not SCCARA members)	1	2	2
Pts for contacts w/Pac. Div. (not SC County)	–	–	1

WHEAT CITY AWARD

This award is sponsored by the City of Brandon and the Brandon Amateur Radio Club and is offered free of charge. To receive the award, work three amateur radio stations in the City of Brandon, Manitoba, Canada if you live outside of Canada. Those living inside Canada must work five stations in the City of Brandon. All contacts must be made after January 1, 1967. Send log data only to: Mr. Doug Bowles VE4QZ, 1104 First Street, Brandon, Manitoba, Canada R7A 2Y4.

The following two awards are sponsored by the Nortown Amateur Radio Club, VE3NAR, PO Box 356, Adelaide Street Postal Station, Toronto, Ontario, Canada. A sworn affidavit certified by a President or Vice President of a legitimate Amateur Radio organization may be submitted in lieu of QSL cards.

WAVE AWARD
WORKED ALL VE AWARD

Contact two different stations on two different bands in each of the following 8 sections: Prince Edward Island or Nova Scotia or New Brunswick (VE1), Quebec (VE2), Ontario (VE3), Manitoba (VE4), Saskatchewan (VE5), Alberta (VE6), British Columbia (VE7), and Northwest Territories (VE8). All contacts must be made from an area within a radius of 150 miles of one point and after January 1, 1939. Submit the 16 QSL cards (or sworn affidavit) with $1.00 or 10 IRCs. All cards will be returned. Return postage must accompany all submissions.

WACAN AWARD
WORKED ALL CANADA AWARD

Contact two different stations on two different bands in each of the following 12 sections: Prince Edward Island (VE1), Nova Scotia (VE1), New Brunswick (VE1), Quebec (VE2), Ontario (VE3), Manitoba (VE4), Saskatchewan (VE5), Alberta (VE6), British Columbia (VE7), Yukon or Northwest Territories (VE8), Labrador (VO2), and Newfoundland (VO1). All contacts must be made from an area within a radius of 150 miles of one point and after January 1, 1939. VO contacts must be made after March 31, 1949. Submit the 24 QSL cards with $2.00 or 20 IRCs and return postage for QSLs. All cards will be returned. Cards submitted for WACAN can be automatically applied towards the WAVE award – please indicate if desired. For holders of the WAVE Award, submit the QSL cards for the remaining four sections (8 QSLs) with $1.00 or 10 IRCs and return postage.

FLORIDA QSO PARTY
1500 to 2000 GMT
Saturday, April 17
0000 to 0500 GMT
Sunday, April 18
1400 to 2400 GMT
Sunday, April 18

The 11th annual QSO Party is sponsored by Florida Skip. Phone and CW are counted as separate contests. The same station may be worked on each band for QSO points and Florida stations may work other Florida stations for QSO points only.

EXCHANGE:
RS(T) and QTH; QTH = county for Florida stations, = state, province, or country for others.

SCORING:
Florida stations count 1 point per QSO. Multiplier is sum of states (49 max), provinces (12 max), and DX countries (12 max). Maximum multiplier is 73. Florida mobiles and portables operating on emergency power and running 200 Watts or less, multiply total score by 2. Out of state stations score 2 points for each Florida portable or mobile station worked and one point for each fixed

CALENDAR

Mar 27 - 28*	Tennessee QSO Party
Mar 27 - 28*	CQ Worldwide WPX Contest – SSB
Mar 27 - 29*	BARTG Spring RTTY Contest
Apr 17 - 18	Florida QSO Party
Apr 3 - 4	Open CD Party – CW
Apr 3 - 4	SP DX Contest – CW
Apr 10 - 11	Open CD Party – Phone
Apr 10 - 11	County Hunters SSB Contest
Apr 24 - 25	PACC
Apr 24 - 25	Delta QSO Party
Apr 24 - 25	BARC Contest – Phone
May 1 - 2	Massachusetts Bicentennial QSO Party
May 1 - 2	Helvetia 22 Contest (H22)
May 8 - 10	Georgia QSO Party
May 8 - 10	Vermont QSO Party
May 8 - 9	BARC Contest – CW
May 15	World Telecommunication Day Contest – Phone
May 22	World Telecommunication Day Contest – CW
June 4 - 7	IARS/CHC/FHC/HTH QSO Party
June 12 - 13	ARRL VHF QSO Party
July 3 - 4	QRP – Summer – Contest
July 3	ARRL Straight Key Night
July 24 - 25	ARRL Bicentennial Celebration
Aug 14 - 15	European DX Contest – CW
Sept 4 - 5	ARRL VHF QSO Party
Sept 11 - 12	European DX Contest – Phone
Oct 8 - 10	CD Party – Phone
Oct 16 - 18	CD Party – CW
Oct 30 - 31	CQ Worldwide DX Contest – Phone
Nov 5 - 8	IARS/CHC/FHC/HTH QSO Party
Nov 6 - 8	ARRL Sweepstakes – CW
Nov 13 - 14	European DX Contest – RTTY
Nov 14	OK DX Contest
Nov 20 - 22	ARRL Sweepstakes – Phone
Nov 27 - 28	CQ Worldwide DX Contest – CW
Dec 4 - 5	ARRL 160 Meter Contest
Dec 11 - 12	ARRL 10 Meter Contest
Dec 31	ARRL Straight Key Night

* = described in last issue

station. Multiplier is number of different Florida counties worked (max 67). Final score is total QSO points times multiplier.

FREQUENCIES:

CW – 1807, 3570, 7070, 14070, 21070, 28070.

Phone – 1817, 3970, 7270, 14317, 21370, 28570.

ENTRIES:

A summary sheet is requested showing the scoring and other pertinent information. Also, your name and address in BLOCK LETTERS, and a signed declaration that all rules and regulations have been observed. Include a 13¢ stamp for results in a future issue of Florida Skip. Mailing deadline is April 30th but late DX entries will be accepted within reason. Send all entries to: Florida Skip Contest Committee, P.O. Box 501, Miami Springs FL 33166.

AWARDS:

Certificates will be awarded to the top single operator score in each state, province and DX country as well as each Florida county for both phone and CW. There are also 5 plaques to be awarded for: High single operator in Florida and out-of-state both phone and CW (4 plaques), and to the Florida club with the highest aggregate score.

At the discretion of the contest committee, stations may be disqualified for improper reporting, excessive dupes, errors in multiplier lists, unreadable logs, obvious cheating, etc. Anyone disqualified in this year's Florida QSO Party will be barred from the contest next year.

SP DX CONTEST – CW

Starts: 1500 GMT
Saturday, April 3
Ends: 2400 GMT
Sunday, April 4

Work as many SP stations during the contest period as possible on all bands 3.5 to 28 MHz. The three categories are: single operator, single and all band; multi-operator, all band only; and SWL. The same station may be worked on each band for QSO points but a powiat may be counted only once as a multiplier. All contacts must be on CW only.

EXCHANGE:

RST plus a 3 figure QSO number starting with 001 for foreign stations. Polish stations will send RST and their powiat letters.

SCORING:

Each QSO with an SP station counts 3 points. Final score is total QSO points times the total number of different powiats worked regardless of bands.

AWARDS:

Certificates to the top scorers in each category, in each continent and each country and call area of Australia, Canada, USA and USSR.

ENTRIES:

Use a separate log sheet for each band and include a summary sheet with all the scoring information. The usual signed declaration is also requested. Usual disqualification rules will apply. Entries should be postmarked no later than April 30th to PZK Contest Committee, P.O. Box 320, Warsaw, Poland.

SIX METER GROUND WAVE CONTEST

Starts: 0300 GMT
Sunday, April 4
Ends: 0700 GMT
Sunday, April 4

The contest is sponsored by the Society For The Preservation and Encouragement of Six Meters and Global Research. It is open to all amateurs, worldwide – on all modes: SSB, CW, FM, AM, SSTV, RTTY, and FAX. Any six meter contact is valid. Skip stations do count in the event the band is open, but they only count ½ point each no matter where the station is located.

SCORING:

For scoring purposes, there are four zones defined by the distance between your QTH and the station contacted. Zone definitions and QSO points for contacts with each zone are as follows: Zone 1, Stations within 25 miles of your QTH – 1 point/QSO; Zone 2, Stations 25 to 50 miles from your QTH – 2 points/QSO; Zone 3, Stations 50 to 75 miles from your QTH – 3 points/QSO; Zone 4, Stations over 75 miles from your QTH – 4 points/QSO.

LOGS:

Show your name, call, address, ARRL section, and input power. Mobiles and portables must show actual locations. For each station worked, show: call, ARRL section, zone (as defined above), time, and points scored. Show your total score, sign the log, and submit to: Phil Caruso K9DTB, c/o Global Research, Contest Chairman, PO Box 271, Lombard IL 60148. Logs must be postmarked by May 3, 1976 for scoring on May 31, 1976. Incomplete logs will not be eligible for awards.

AWARDS:

All entries will receive a certificate from SPESM. The first place total score in each category will receive a prize. Prize categories are as follows: Mobile – any mode or power; Portable – any mode or power; High power – 100 Watts or more; Medium power – 51 Watts to 99 Watts; Low power – 50 Watts or less.

Any questions concerning rules can be answered by K9DTB (Phil) at 312-279-4658 or through SPESM. All prizes are donated by Global Research.

NOVICE QSO PARTY

Starts: 0000 GMT
Saturday, April 10
Ends: 0600 GMT
Sunday, April 11

The fifth annual Novice QSO Party is sponsored by the International Novice Amateur Radio Assoc. Any class amateurs work only Novices and work each station only once regardless of bands. Please use "CQ NP" for contest call and use the lower 10 kHz of each Novice band. The following are considered as Novices: EL#Nx, HC#Nxx, HI#Nxx, KG4Nxx, KZ5xxN, LB#xx, OA#Nxx, OL#xxx, VU2xxx, WH6xxx, WL7xxx, WN#xxx and WP4xxx (or bicentennial equiv.).

EXCHANGE:

RST and name.

SCORING:

Novices multiply total number of QSOs by total number of different prefixes worked (K1xxx & WA1xxx are different prefixes, etc.). Non-Novices multiply total number of contacts by the number of different Novice prefixes worked (WN4, WN8, OA3N, OA2N, etc.).

ENTRIES:

To qualify for awards, mail logs no later than May 1st to: Andi Anderson WB5MYV, Route 1 Box 193, Heavener OK 74937. Include an SASE for results.

COUNTY HUNTERS SSB CONTEST

Starts: 0001 GMT
Saturday, April 10
Ends: 2400 GMT
Sunday, April 11

The fifth annual County Hunters SSB Contest is sponsored by the Mobile Amateur Radio Awards Club, Inc. (MARAC). Basically, the rules are as follows: Mobile stations may be worked each time they change

Continued on page 32

RESULTS

RESULTS OF THE 1975 DELTA QSO PARTY

Plaque winners are as follows: high score, Delta Division – W5DRW; high score outside division – KØGJD/6; high score, portable station – WB4DJU/4; high score, mobile station – WA5KOD/5. Only WA3VWJ/5, W4CHK and KØGJD/6 worked five stations in each of the four states in the Delta Division for the Delta Achievement Award. Results of a contest survey are available, for a large SASE and two first class stamps, from W5RUB. The first place station in each section is as follows:

DELTA DIV.	CALL	# QSOs	SECTIONS	POINTS
ARK	W5DRW (WA5RTG op)	324	62	20,088
LA	W5WG	299	60	17,940
MISS	W5RUB/5*	584	55	32,120
	K4EOH/5	210	47	9,870
TENN	WB4RJF	232	47	10,904

* = not eligible for plaque

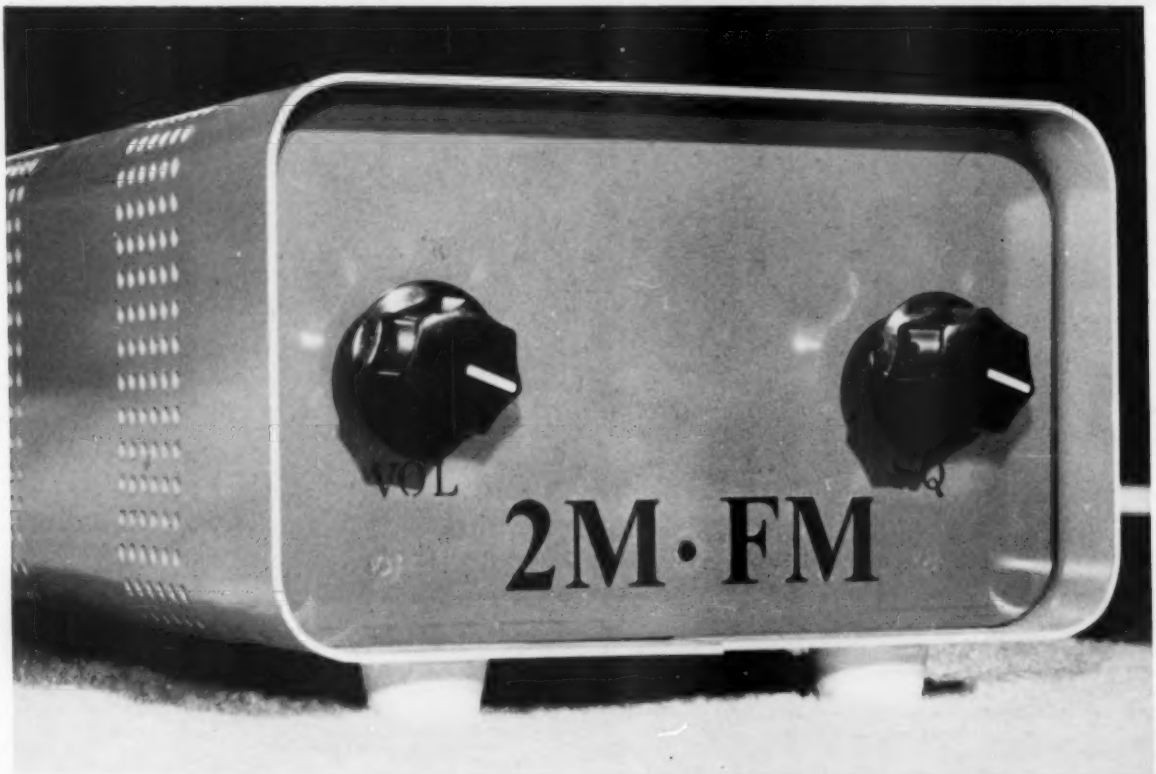
SECTION	CALL	# QSOs	COUNTIES	POINTS
CONN	WA1KMP	29	25	725
E. MASS	W1AQE	71	45	3,195
NH	WB6IPR/1	13	11	143
VT	K1IIK	5	5	25
ENY	W2WSS	30	19	570
NLI	W2RPZ	77	42	3,234
NNJ	WA2DFC	40	24	960
WNY	W2NCI	73	40	2,920
EPA	W3EFY	19	15	285
MD	W3RAB	76	40	3,040
WPA	W3HDH	16	13	208
GA	WB4QGN	72	39	2,808
KY	W4KFB	47	25	1,175
NC	W4OMW	32	21	672
NFLA	K4DDB	34	20	680
SC	K4HQU	46	29	1,334
SFLA	K4HWW	86	35	3,010
VA	W4CHK	113	59	6,667
NTEX	W5SOD	40	23	920
STEX	WA3VWJ/5	74	39	2,886
LA	WAØKXJ/6	12	12	144
ORG	KØGJD/6	124	57	7,068
SBAR	K6QPH	5	5	25
SJV	K6TG	13	9	117
ARIZ	WB7BQN	9	9	81
IDAHO	W7GHT	44	29	1,276
ORE	WA7GOO	22	17	374
MICH	W8WVU	50	29	1,450
OHIO	W8RYP	7	7	49
WVA	K8LOU	10	9	90
ILL	W9VEN	50	28	1,400
COLO	KØQIX	59	33	1,947
MO	WBØNOU	8	7	56
NDAK	KØITP	3	3	9
CANADA				
MAR	VE1AHG	16	15	240
ONT	VE3EJK	65	36	2,340

by
Jim Huffman WA7SCB
P.O. Box 357
Provo UT 84601

Yes, You Can Build This 2m Receiver!

Chances are no one has to tell you how great it is up on "2." You may already have at least one rig on two, or wish you had one. Either you or some of your ham buddies may operate the local repeater(s) and maybe your club even has a repeater. If, however, by some strange uncanny phenomenon, you don't know how good it is on two meters, you'd better build yourself this receiver. If you're like most hams and already have a handle on two meters, build this unit and you can have a good back up receiver, monitor your calling repeater (no matter which one you're working), or spend a few extra dollars to add a transmitter for a dandy economical little FM rig.

For somewhere in the 35 dollar range you can receive two meter signals in the fraction of a microvolt range, run off a handful of batteries, the house current, or the auto battery, and know what's happening on two.



A simple, inexpensive transmitter is on the drawing board as a companion for the thing and there is plenty of room for it in the cabinet. If your junk box is full to the brim, you can probably build this unit for the cost of some of the ICs and the circuit board, etc.

The whole receiver was designed with an eye to the cost vs. performance ratio. You get the best performance possible at the lowest cost. You can leave out some of the circuits if your budget is a little strained. Sort of a "put the squelch on layaway" program. The circuit design uses the right combination of ICs and discrete circuits to give good performance and still save on the cost of the unit. Also, consideration was given to the overall circuit-by-circuit cost; that means you don't pay only a quarter for an IC (bargain, huh?) and then have to add $5.00 worth of external components to make it work. You get the best choice as far as the combination of the IC cost and external components.

Fig. 1 shows the block diagram of the receiver. The receiver is a simple, single conversion unit with no frills. As mentioned before, you can add the frills later. For instance, there is no fancy ten-pole crystal filter in the i-f, but there is enough room on the circuit board to add it for those who need it. After all, why should those of us who have only one or two repeaters in the area, on widely separated frequencies at that, pay for that added selectivity? If the action gets too hot up there later, we can add the circuit. It is a lot easier for the poor amateur to liberate ten dollars here and there than to spend 50-60 bucks a whack.

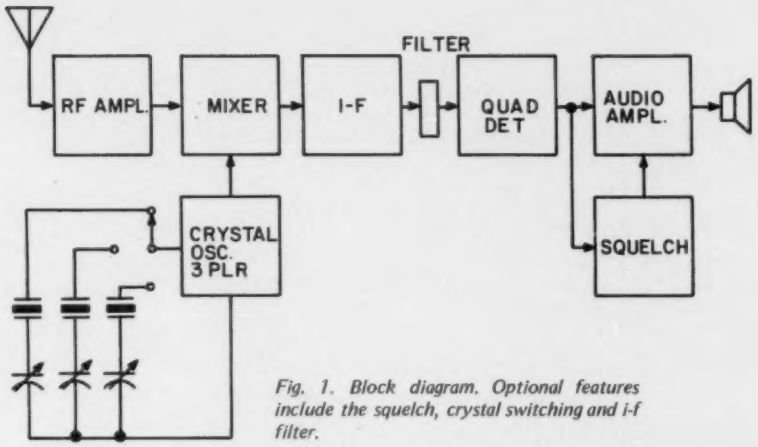


Fig. 1. Block diagram. Optional features include the squelch, crystal switching and i-f filter.

Fig. 1 shows that the incoming signals are converted to a 10.7 MHz i-f. The front end is FET and the i-f amp is an IC. The quadrature detector is also an IC. The IC audio amplifier is protected so you can disconnect it with the audio going full blast. This allows you to use a variety of speakers, headphones, etc., without worrying whether gross impedance mismatches will ruin the receiver. The squelch is treated as an option, although there are those who feel a receiver without squelch is unthinkable. It is a little noisy up there on two, so the squelch is a good one. It will operate external buzzers, relays and lights, as well as switching the audio. You can operate a buzzer with a telephone handset operation to impress the boys in the carpool, or to soothe the XYL who can't stand to hear the squelch breaking. You have a Watt or two of audio which will work fine for all but the noisiest sports cars. The entire receiver draws about 100 mA. That amount won't run your nicads down for a few hours,

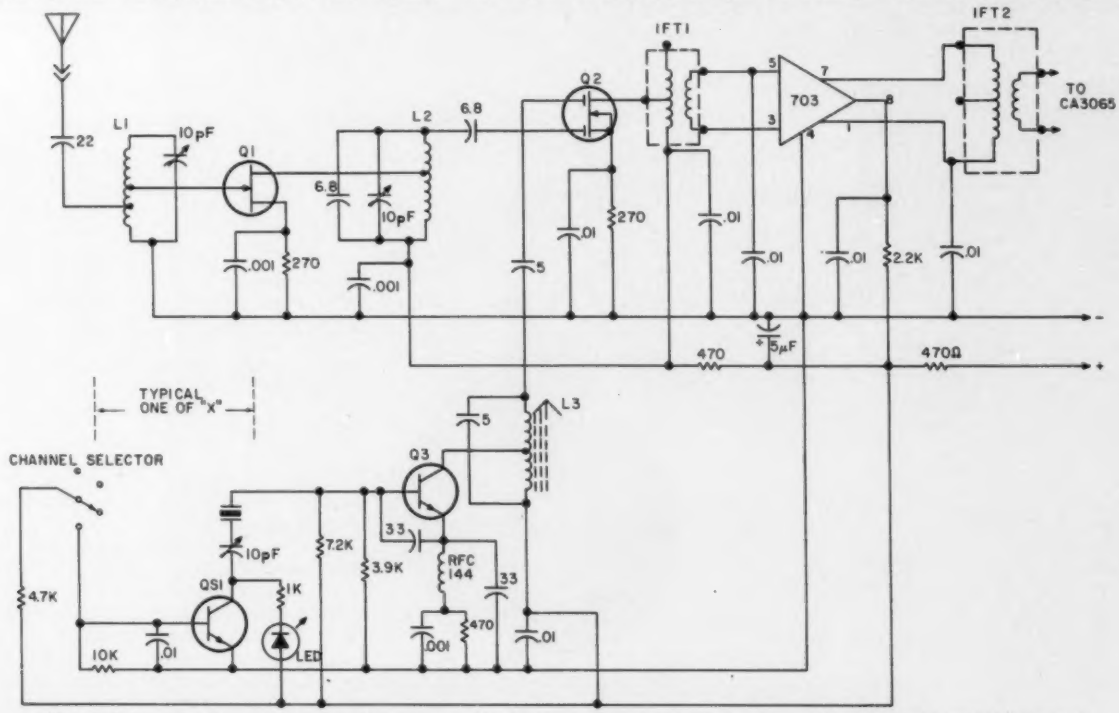


Fig. 2. Schematic diagram (continued on next page). Optional channel selector is shown. Q1: GE FET 2, F0021, MPF102, 3N128. Q2: 40673, 3N140*. Q3: 2N2222. Q1-X: 2N2222*. L1: 7T #18 3/8"d 5/8"l, tapped 1T and 2T from cold end. L2: 5T #18 3/8"d 7/16"l C.T. L3: 5T #18 ¼" cerform, tapped 1¼T from cold end. *See text.*

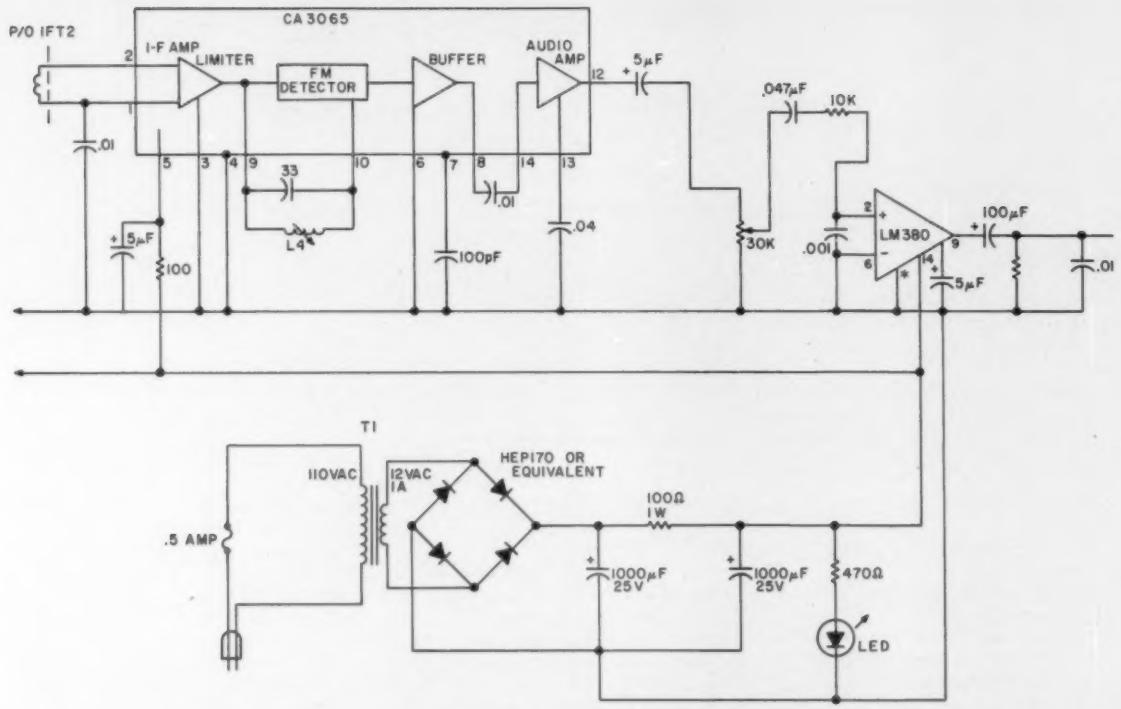


Fig. 2. (continued).

and you'll never notice the new addition to the electric bill.

A look at the schematic, Fig. 2, shows that the oscillator and tripler circuit are one and the same. This circuit uses crystals which triple in the same way the Regency folks do in the HR-2 (or so I'm told). That means you can order your crystals from the inexpensive units that advertise in 73 all the time offering their crystals for particular units, to that unit's specs. To find the crystal frequency, subtract 10.7 from the repeater or other desired frequency in MHz, then divide by three. For a 146.94 unit, the frequency is 136.26 and the crystal frequency is 45.42 MHz. I have had a lot of success with Jan Crystals units selling for $4.00 each; just order for the series mode.

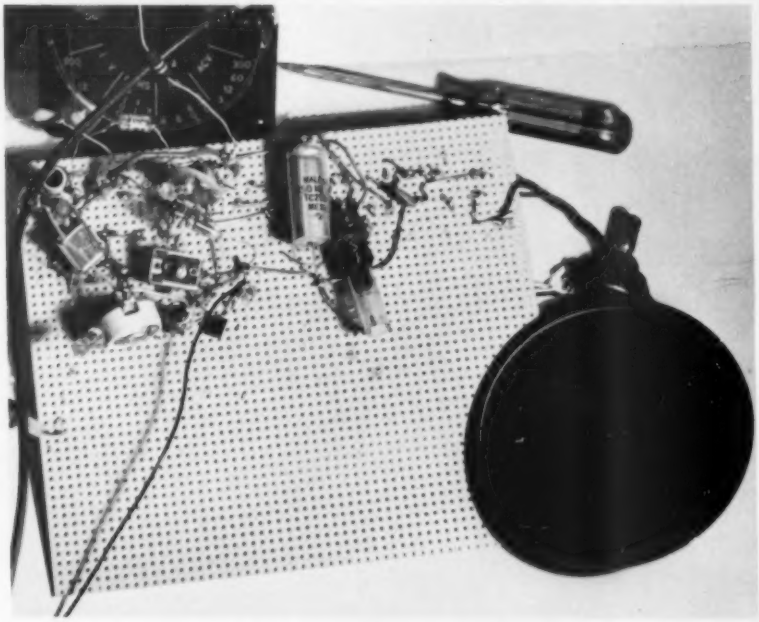


Fig. 3. This is the prototype layout. If this thing worked (and it did, very well) just about anything you can dream up should work with no problem. See the text for pointers on some pitfalls in laying out the receiver.

The dual gate mixer and JFET front end provide good overload immunity and help guard against cross-modulation effects. If you find the agc-less receiver suffering from overload in your application, just add the rf gain control shown in Fig. 5.

The i-f stage uses the familiar 703 op amp. Although I have read reports of people having bad luck with the op amps, I find them extremely stable when treated right. Just keep the leads short and bypass close to the case. You won't have any trouble at all.

The limiter, detector, and audio preamp stages are part of an IC that is unique in that its original application was in the 4.5 MHz audio i-f of TVs. If that scares you, you are welcome to the popular CA3089 IC. The 3089 has built-in squelch, but the cost is nearly 4 dollars as compared to less than 75¢ for the CA3065 used here. The squelch circuit can be added for around a buck and a half or less and is far more versatile than the squelch in the CA3089. The CA3065 uses few external components in this application and will do the job well. Ignore the spec sheet that may come with the unit, unless you

TH6DXX

SUPER THUNDERBIRD

The Ultimate Tri-Band

No other antenna gives you performance on 10, 15 and 20 meters equal to the TH6DXX Super Thunderbird. It's built, without compromise, to be electrically and mechanically superior to everything else.

Separate "Hy-Q" traps are used for each band and they are factory tuned for peak performance. You can get optimum results on transmission, phone or CW, with the easy-to-use tuning charts we supply.

The cast aluminum, tilt-head, boom-to-mast bracket accommodates masts from 1¼" to 2½" and provides mast feed-through for stacking with other antennas. Taper-swaged, slotted aluminum tubing is used for easy adjustments and light weight. Full circumference compression clamps are used throughout, instead of the usual, self-tapping screws. All element-to-boom brackets are formed from extra heavy gauge aluminum.

Hy-Gain's exclusive Beta Match is used to give optimum matching on all three bands and a positive DC ground path.

For tri-band DX, nothing can beat the Super Thunderbird.

Up to 9.5 dB gain over ½ wave dipole
3 active elements on 20 and 15 meters
4 active elements on 10 meters
25 dB front-to-back ratio
SWR less than 1.5:1 on all bands at resonance
24′ boom, 20′ turning radius
6.1 sq. ft. surface area, net weight 61.5 lbs.
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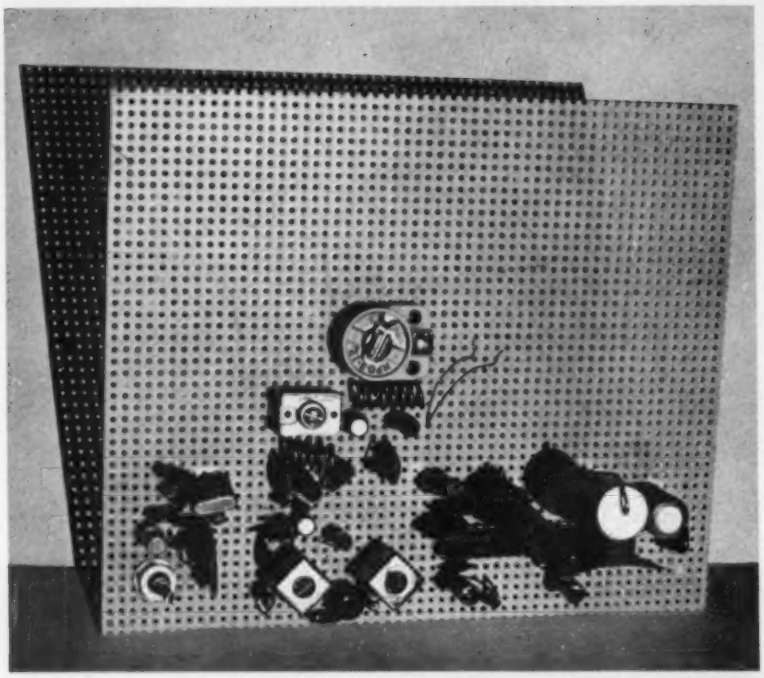

Fig. 4. This is the final layout of the breadboarded receiver circuit. Stick with this one, and you'll have room enough for add ons, and a stable receiver design.

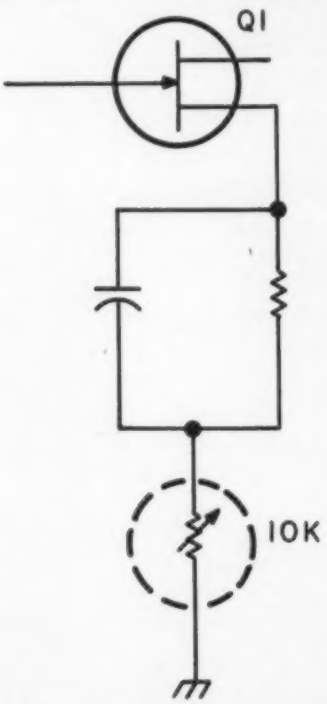

Fig. 5. Installing a 10k rf gain control in Q1 emitter when overload is a problem. When using the unit as a fixed station, it may be a trimpot "set and forget" control. Adjust for maximum gain/minimum cross modulation.

want to do a lot of experimenting. The values given work nicely.

The audio output stage uses the LM380 IC. The 380 puts out better than a Watt with a 12 volt supply and will be adequate for most applications. The best features of the IC are its very low cost ($1.60) and the few external components it requires. The gain is fixed at a maximum limit like the 703 op amp and this gives it a lot of stability as long as good layout is used.

Construction

You can use just about any layout you want. If you use my layout, you will likely have better results right away since mine is proven. You certainly should try your own if you have something in mind as the simplicity of this receiver makes it a candidate for miniaturization. If you do try another layout just try to keep inputs and outputs that are at or near the same frequency separated, shielded, or both. Note, in the PC diagram, how the ground bus is used to provide shielding between stages. The i-f system in this unit has very high gain; the CA3065 was designed to be the sole i-f amplifier in a TV system, so the addition of the 703 op amp can bring the system gain as high as 90 dB. That is pretty hard to keep stable without keeping the inputs and outputs well apart.

Just look at Fig. 3. This was the prototype circuit board while the developmental work was being done. If that worked, just about anything you dream up should suffice. Fig. 4 is a photo of the final layout. The receiver is shown as a prototype layout and there is room for the squelch circuit (layout not shown), crystal switching, even for a transmitter. You'll be reading about the add ons to this receiver later; in fact, you may even have something unique in mind for your own. If you use the same cabinet I did, there will be plenty of room for adding a power supply and the speaker mounts easily in the unit.

Substitutions

Any good ham is interested in using junk box parts in building anything, but sometimes the junk box is not full of the values the schematic calls for. For starters, you can save some money by getting the three MOSFET pack from your local Radio Shack for less than $1.50. Use two in the receiver and add one to the junk box. The gates aren't protected, but I have more static in my carpet than rf in my transmitter, and using just reasonable caution and discharging myself before handling them, I have not burned out a single gate. The 3N128 single gate makes a good front end. The 3N140 makes a dandy mixer. You can substitute paper coil forms for the ceramic forms. Better choices are the resinite forms, those brittle plastic looking things you've seen around. You probably noticed that the crystal switching circuit is strange. If you want to leave out the QS stages and just use the switch, just remember to use a layout like mine that puts the oscillator near the front of the case, so the switch leads will be shorter. Just ground the lug of the crystal tuning capacitor rather than connect it to the collector of QS. The QS stages are not given in the PC layout.

In the i-f stages, you may steal the i-f transformers from a transistor radio (1) if it had FM and (2) if you can identify the 10.7 MHz transformers from the 455 kHz transformers in the case of an AM/FM. Use the mixer transformer from the radio as the mixer transformer in the receiver and use the radio's i-f T2 as i-f T2 in the receiver. For saving another quarter, use the bipolar transistor (if it's NPN) from the radio for the local oscillator. Be sure to use either the front end or the oscillator/mixer transistor as Q3. Oh yes, while you're cannibalizing, you may as well use the radio's volume control and/or tone control for the volume and squelch controls. Check the values to insure they are 50k or lower.

The true parts substitution nut will love this last one. Don't even use coil forms or trimmer capacitors. The heavy coil windings can be wound so that a ferrite core from a coil form (the threaded interior type) will fit inside along with a little tape or plastic sheet to insulate the thing. The slug will move in and out of the coil when you turn it since the pitch of the windings acts like threads in the coil form. You no longer need trimmer capacitors because the coil is slug-tuned. Naturally, since the inductance increases you will need to find a value for the fixed

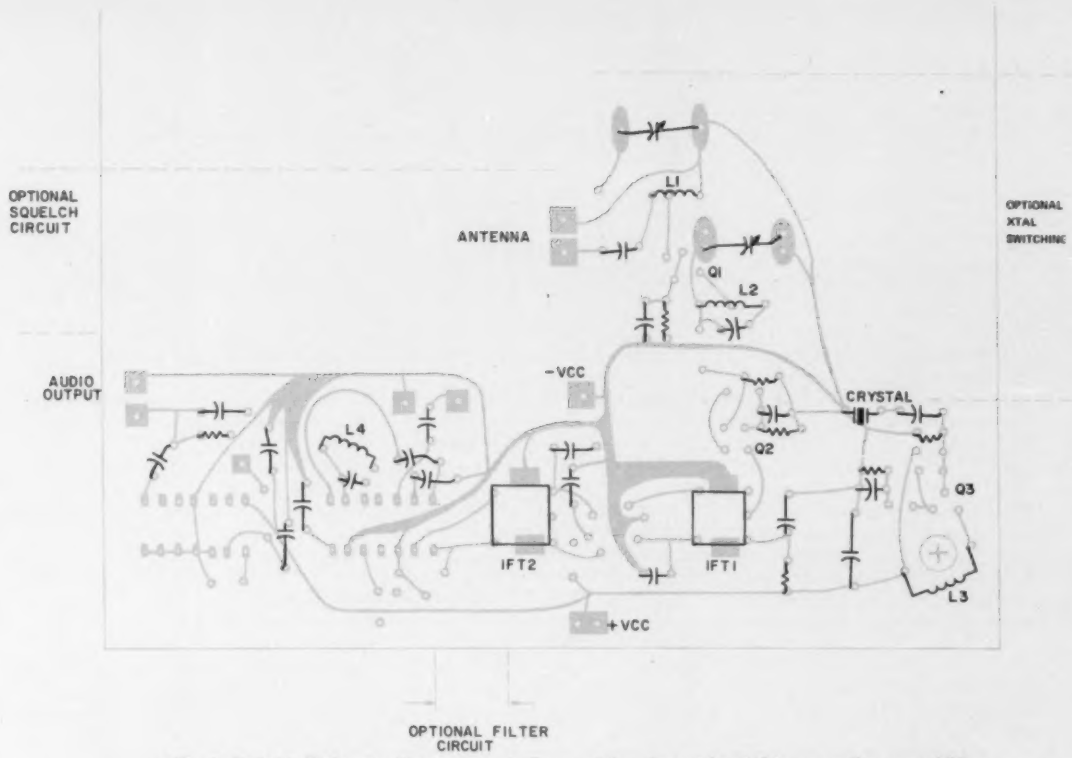

Fig. 6. Foil side PC layout. Note open areas for squelch and crystal switching, as well as crystal filter.

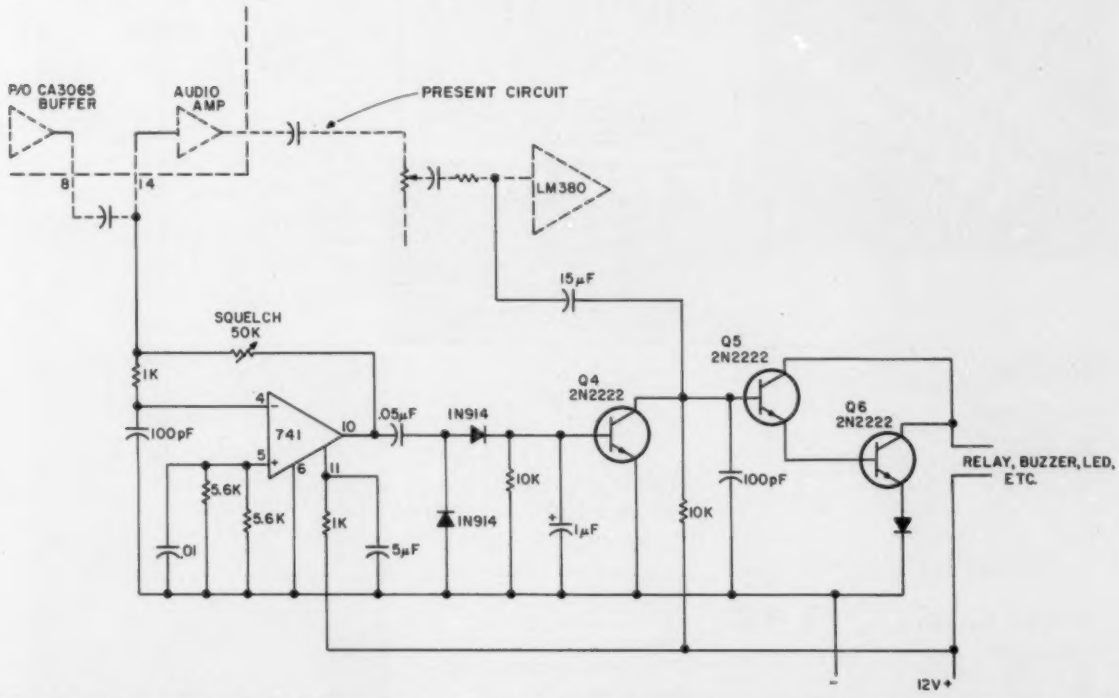

Fig. 7. Squelch circuit. Q5 and Q6 are an option to the option. They will operate a buzzer, or whatever. You will probably want to add a switch to the audible signal so it can be cut when you are in QSO.

capacitor experimentally. A grid dip meter should suffice. Don't worry too much about hurting circuit Q because the FETs don't care, and the Q in the oscillator circuit is not that critical to proper operation. You will still have to use a form for the quad detector coil since it is a relatively high-inductance unit.

Optional Circuits

While you may not consider some of the optional circuits optional, they really aren't basic to the functioning of the receiver and can be added later if you don't wish to do so now. Fig. 7 shows the squelch circuit. The optional crystal switching is part of the main schematic, Fig. 2. The crystal filter circuit is shown in Fig. 8, and the PTI2194F Piezo Technology Comline filter should do the trick. You can find a slew of preamplifier circuits if you feel the need to add one to the front end. And diode protection, back to back 1N914s across the input rf amp gate, is recommended when using the receiver with a companion transmitter. This protection may not be necessary, but can't hurt since it will cost only a quarter more and might save the front end from damage from the nearby rf.

Tuneup

Accomplishing tuneup is easy. First align the i-f, then the rf stages. With an input from a signal generator or grid dipper align the quad detector for minimum noise output.

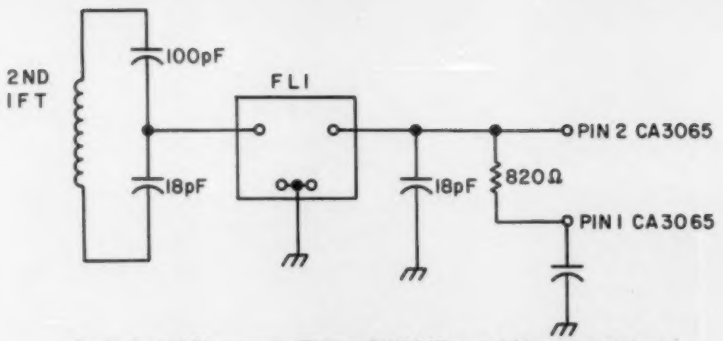

Fig. 8. Crystal filter circuit. FL1 is a PI12194F crystal filter or equivalent.

Keep switching the rf on and off so you make sure you have noise without signal, no noise with; that way you don't accidentally detune the thing way off frequency thinking you're right on. Next peak the i-fs for minimum noise. Tune up the front end by giving it a signal on two meters, a gdm is fine, and again tune the front end for maximum quieting. Tweak the oscillator for maximum quieting. Then accomplish final tuneup with weak signals on the band when possible. For a sensitivity check without 2 meter signals use the gdm. You should be able to quiet the receiver from as far away from a 19 inch whip or piece of wire as you can your communications receiver. If you have a two meter FM receiver already, you can use its sensitivity as a reference. If all is well with your wiring you can stir up some action on the band.

You should enjoy this receiver. The satisfaction of knowing you built it yourself, as well as knowing how much money you saved over available commercial units should make it a fun experience. The money you save building this unit and a companion transmitter could buy the XYL a nice gift. And then maybe she'll even start encouraging this nutty hobby of yours. Of course, you can also use the left over money to buy yourself another piece of ham gear, or since you've got it sitting around, perhaps you'd consider using it to make up the difference in this week's and last week's grocery bills. ■

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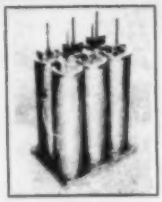

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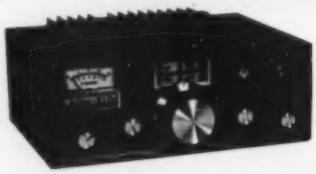

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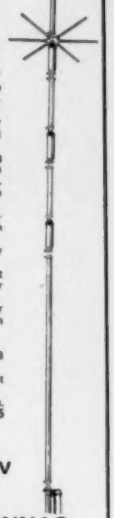

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PA4810H W/T	same as above — factory wired and tested	74.95
PA144/15 Kit	2 meter power amp — 1w in — 15w out — less case, connectors and switching	39.95
PA144/25 Kit	similar to PA144/15 kit except 25w out	49.95
PA220/15 Kit	similar to PA144/15 for 220 MHz	39.95
PA432/10 Kit	power amp — similar to PA144/15 except 10w and 432 MHz	49.95
PA140/10	10w in — 140w out — 2 meter amp — factory wired and tested	179.95
PA140/30	30w in — 140w out — 2 meter amp — factory wired and tested	159.95
HT144B Kit	2 meter — 2w — 4 channel — hand held xcvr with crystals for 146.52 simplex	129.95
RPT144 Kit	repeater — 2 meter — 15w — complete (less crystals)	465.95
RPT220 kit	repeater — 220 MHz — 15w — complete (less crystals)	465.95
RPT432 Kit	repeater — 10 watt — 432 MHz (less crystals)	515.95
RPT144	repeater — 15 watt — 2 meter — factory wired and tested	695.95
RPT220	repeater — 15 watt — 220 MHz — factory wired and tested	695.95
RPT432	repeater — 10 watt — 432 MHz — factory wired and tested	749.95
PS3 Kit	12 volt — power supply regulator card	8.95
PS15C Kit	NEW — 15 amp — 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	79.95
PS15C W/T	same as above — factory wired and tested	94.95
PS25C Kit	NEW — 25 amp — 12 volt regulated power supply w/case, w/fold-back current limiting and overvoltage protection	129.95
PS25C W/T	same as above — factory wired and tested	149.95

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COR2 Kit	complete COR with 3 second and 3 minute timers	19.95
SC3 Kit	10 channel auto-scan adapter for RX	19.95
Crystals	we stock most repeater & simplex pairs from 146.0-147.0 (each)	6.00

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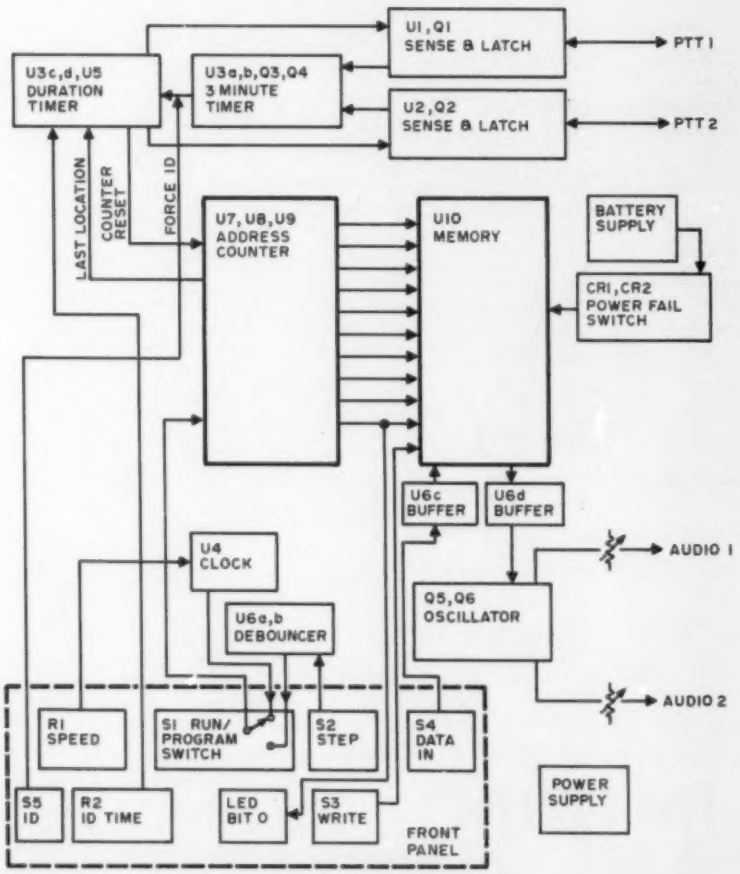

Fig. 1. Block diagram.

There are a large number of repeaters on the air these days, and most have CW identifiers. The CW operator who takes a sojourn into the repeater bands is inundated with repeater callsigns. After a day or two on the same repeaters, listening to the dull but prevalent "DE WR3ABQ" type of repeater identification becomes rather boring. Being an avid CW operator as well as repeater user, I decided that a more interesting type of repeater identifier could easily be built. It was decided that the identifier should:

1. Be easily reprogrammable (without opening the case).
2. Have capacity for long messages.
3. Retain its memory during power failures.
4. Service two repeaters.
5. Be relatively inexpensive (under $40).

The identifier was to be used at a site where two repeaters are located with the same callsign (150 and 450) – hence the fourth point.

An identifier was designed and constructed which satisfied the above requirements. It is programmed from switches on the front panel, has a 1024 bit non-volatile memory, identifies two repeaters, and costs about $30 to $40 to build (with new parts).

Other Identifiers

The distinguishing feature of identifiers is the memory. Identifiers may be classified according to the type of memory they use. There are basically two kinds of electronic identifiers in use today. The first and older of the two uses a diode matrix for memory. The identifier is programmed by soldering diodes in a matrix. The disadvantages of this system are that large memory units become cumbersome, and that reprogramming entails opening the unit and physically moving diodes around.

The other type of identifier uses read only memory (ROM). These are fairly new devices and can store more in less space than a diode matrix. Typically, fusible link ROMs are used because these are the most inexpensive. The fusible link ROM is programmed by selectively melting fusible links inside the integrated circuit chip. Naturally once a link is melted there is no way to put it back. Generally a ROM of this type can be programmed only once. However, to change the identification in this type of identifier it is only necessary to reprogram another ROM chip and replace the old ROM with the new one.

The latter type of identifier is more easily changed than the former, but still lacks versatility in that a different chip must be purchased every time it is desired to change the identification. This would become impractical if the memory were to be changed every few weeks.

There are alternatives to the fusible link ROM. There are available programmable, erasable ROMs. These can be erased by exposure to ultraviolet light. However, a specialized and complex programmer unit is needed in order to program them. These chips are presently in the $20 price class.

There is another type of memory which, in the past, has not been used in identifier circuits. This is random access memory, or RAM. This type of memory is electrically programmable. Moreover, the 2102 static RAM has 1024 bits of storage and sells for about five dollars. There is one disadvantage to using this kind of memory – it is volatile, which means that when the power is turned off the contents of the memory are lost. Both the diode matrix and ROM are nonvolatile. A power fail battery can make the RAM immune to short line power failures. The reprogrammable identifier uses such a system.

Theory of Operation

Fig. 1 is a block diagram of the identifier. The oscillator generates a sidetone with two variable level outputs for the repeaters. The memory unit keys the oscillator, and an address counter drives the memory. The identifier has two modes of operation: program and run. The run mode is normal operation, and the program mode allows the memory to be programmed. In the program mode, the address counter is incremented by a push-button on the front panel, and ones and zeros can be written into the memory through the front panel. In the run mode, the address counter is driven by a free running clock. The clock determines the CW speed and is controlled by a potentiometer on the front panel.

A duration timer controls the address counter. When it is low (normally), it inhibits the address counter from being toggled by the clock, and holds the counter at address zero. When it is time for an identification, the duration timer goes high and allows the address counter to count. The timer then falls low (indicating that the identification is over) and resets the address counter. It is the duration timer which determines whether the identifier is identifying or not.

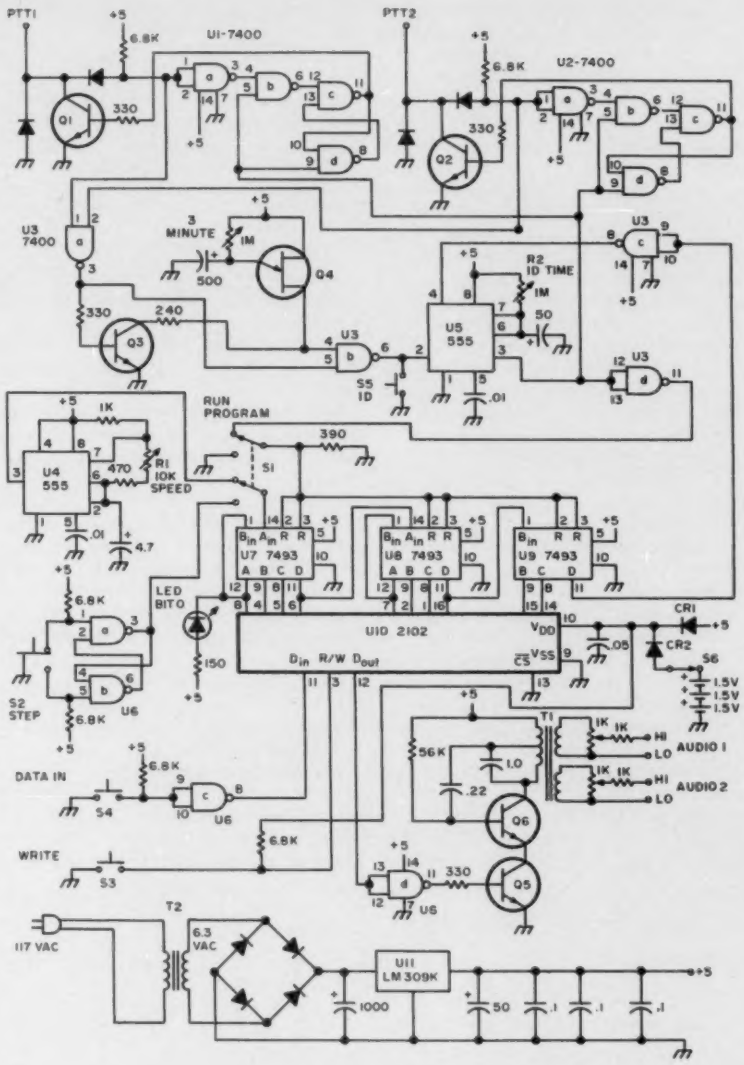

Fig. 2. Schematic.

The duration timer is controlled by a three minute timer. This timer does two things: If the repeaters have not been used for three minutes, upon key-up the timer will send a pulse to the duration timer to initiate an identification. Additionally, if the repeater remains on the air, the timer pulses the duration timer every three minutes.

The three minute timer is controlled by two identical sense and latch circuits. The sense and latch circuits go to the push-to-talk lines of the two repeaters. If either of the push-to-talk lines is grounded, the three minute timer is activated. If the duration timer is high when a push-to-talk line is low, the latch on the respective sense and latch circuit is set, which grounds that push-to-talk line to keep the repeater on the air. When the duration timer goes low the latch is reset, letting the repeater drop.

A power supply feeds the electronics, but when power is lost, the memory is switched to internal batteries.

The schematic of the identifier is shown in Fig. 2. The memory consists of a 2102 RAM. The 2102 is an nMOS integrated circuit and has TTL compatible inputs and output. The chip has ten address lines necessary to access 1024 bits. When a particular address is selected, whatever is present at the D_{in} terminal is stored in that location when the read/write (R/W) line goes low. When the R/W is high, whatever was previously stored will be present at the D_{out} terminal when that address is again selected.

The oscillator utilizes an 88 mH toroid coil with two secondary windings. The audio outputs of the identifier are low impedance. With the component values specified, the tone is 1 kHz.

The address counter consists of three 7493 four-bit binary counter chips. The reset lines are tied together and go to the complement of the duration timer.

The clock is a 555 square wave generator. Another 555 is used as a monostable multivibrator for the duration timer. When the input is pulsed, the output is a pulse of predetermined width (5 to 60 seconds).

A unijunction transistor is used as the three minute timer in conjunction with Q3 and part of U3.

The latches are RS flip flops. The reset lines go to the duration timer's output, so the latch outputs are held low until the duration timer goes high, whereupon the set line may go low if the push-to-talk line is low. When the latches are set, Q1 or Q2 is turned on and holds up the respective repeater. When the duration timer goes low, the latches are reset again.

The step control goes to an RS flip flop used as a debouncer, which toggles the address counter. Bit zero of the address is monitored on the front panel by an LED.

The power supply uses a full wave rectifier to an LM309K regulator chip. Three "D" cells in series provide emergency power for the 2102.

Construction

All of the parts used in the identifier are readily available. All of the integrated circuits used are sold by James Electronics. All transistors except Q4 are general purpose NPN silicon and can be bought in bargain packs. The transistors used for Q1 and Q2 should be rated for whatever current the push-to-talk line of the repeaters requires. Q4 is a unijunction and is sold at Radio Shack as #276-111. The diodes are all general purpose silicon and can be bought from bargain packs, with the exception of CR1 and CR2, which should be germanium and capable of passing 70 mA. The oscillator coil is a centertapped 88 mH toroid coil and can be obtained from M. Weinschenker. Two windings of about 25 to 50 turns should be added to the toroid for the outputs. The power transformer is Radio Shack #273-1384. The components used in the timing circuits (particularly the capacitors) should be high quality units.

The prototype was built on a patchboard type of printed circuit board using Molex sockets and jumper wires. Point to point wiring using integrated circuit sockets on vectorboard should work fine. Particular care should be taken to make ground and Vcc lines out of heavy bus wire, with extensive bypassing with .1 uF capacitors. The logic is not being used very fast, but the chips will respond to pulses of several nanoseconds in length, necessitating good rf construction practices. The unit was built into a Radio Shack plastic box with aluminum cover, but it would be better practice to use an all metal enclosure to keep rf out.

Address	Contents	Address	Contents	Address	Contents	Address	Contents
0	0	30	0	60	1	90	0
1	1	31	1	61	1	91	0
2	1	32	0	62	0	92	0
3	1	33	1	63	0	93	0
4	0	34	1	64	0	94	0
5	1	35	1	65	1	95	0
6	0	36	0	66	0	96	0
7	1	37	1	67	1	97	0
8	0	38	0	68	0	98	0
9	0	39	0	69	1	99	0
10	0	40	0	70	1	100	0
11	1	41	1	71	1	101	0
12	0	42	0	72	0	102	0
13	0	43	1	73	1	103	0
14	0	44	0	74	0	104	0
15	0	45	1	75	0	105	0
16	0	46	0	76	0	106	0
17	0	47	1	77	1	107	0
18	0	48	1	78	1	108	0
19	1	49	1	79	1	109	0
20	0	50	0	80	0	110	0
21	1	51	1	81	1	111	0
22	1	52	1	82	1	112	0
23	1	53	1	83	1	113	0
24	0	54	0	84	0	114	0
25	1	55	0	85	0	115	0
26	1	56	0	86	0	116	0
27	1	57	1	87	0	117	0
28	0	58	0	88	0	118	0
29	0	59	1	89	0	119	0

Table 1. Example of programming a typical ID: "DE WR3AFM."

Adjustments and Programming

Programming the identifier is a simple matter. The address counter counts up from zero at a constant rate. A zero in a location produces no tone and a one produces a tone. As the counter counts from zero up, a tone will be generated whenever a one is encountered. Since the identifier rests at location zero, a zero must be programmed in that spot, or the repeater will have a constant tone on it. A dit should be one location long, and a dah three. A single zero should follow dits and dahs within a character, and three zeros should follow each character. Characters at ends of words should have seven zeros after them. Table 1 shows the desired encoding for a typical repeater call. As can be seen, "DE WR3AFM" requires only 83 bits out of the 1023 available, so much longer identifications will fit into the memory.

To program the memory with the desired code, apply power and wait for the LED to stop flashing. Backing off the ID time control will stop it. When the light remains on, the address counter will be at location zero. Flip the mode switch into the program mode. To write into the memory, the write button must be depressed with the Data In button down for a zero, and up for a one. A zero should be written in location zero. Push the step button, and the LED should go out, indicating that the counter is now at location 1. Program a one, and proceed on in this manner until location 83 is programmed. It should be noted that there is no way to go back a count, so if a mistake is made the procedure should be started over. A number of zeros should always be placed after the message to give leeway to the duration timer. Put the mode switch back to run and push the ID button. Set the speed control for the desired speed, and then adjust the ID time control so that the counter resets about five seconds after the ID is done. If a mistake is noticed, hit the ID button again, but place the mode switch into program just before the location where the mistake is located. This makes it unnecessary to step through the entire ID when a mistake is near the end. The counter remains where it was before it is placed into the program mode. After programming a message, tie a push-to-talk line low, and measure the time between identifications. Adjust the 1 megohm trimpot for the desired time – nominally three minutes.

Results

After wiring, the only problem encountered was one of the Vcc lines being too small and poorly organized. After remedying this problem, the identifier had no other problems. After the unit was in operation about a month the speed began to slowly vary. Replacement of the components in the clock circuit fixed this problem. The identifier is located in the bottom of a 450 MHz repeater cabinet, next to a 150 MHz repeater, in a building with dozens of 150 MHz and 450 MHz repeaters. There has been no problem with rf getting into the identifier, even though it is constructed in a plastic case. The identifier has been installed for several months and has been working continuously on the Baltimore Amateur Radio Club's 146.07/146.67 and 444.35/449.35 repeaters. The batteries have not been replaced, and they have been successful in retaining the memory when power failures have occurred. It generally takes between five and fifteen minutes to program the identifier. BARC repeater users have been listening to the CW as it spouts notices and comments. If nothing else, this type of identifier makes users cognizant of the fact that the tones actually say something, and are not something to be constantly ignored, as is the case with too many repeaters across the country. ■

Parts List

CR1, CR2 – germanium diodes, 70 mA
Q1, Q2, Q3, Q5, Q6 – general purpose NPN silicon (2N3904)
Q4 – unijunction (Radio Shack #276-111)
R1 – 10k potentiometer with switch
R2 – 1M potentiometer
S1 – DPDT toggle switch
S2 – momentary push-button SPDT
S3, S4, S5 – momentary push-button SPST
S6 – SPST mounted on R1
T1 – 88 mH centertapped toroid coil with two 50 turn windings added
T2 – 6.3 volt power transformer (Radio Shack #273-1384)
U1, U2, U3, U6 – 7400 quad NAND gate
U4, U5 – NE555 timer
U7, U8, U9 – 7493 four bit binary counter
U10 – 2102 1k static RAM memory
U11 – LM309K voltage regulator

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CONTESTS

from page 17

counties or bands. They may be worked on different bands in each county for point credit only. Mobile stations contacted on a county line count as one contact but two or more multipliers. Portable stations that change counties during the contest may be worked for both point and multiplier credit from each new county. Fixed stations may be worked by other fixed stations only once during the contest regardless of bands. Fixed stations may be worked, however, by mobile stations each time the mobile station changes counties or bands. Repeat contacts between mobile stations are permitted as long as they are on another band or at least one of the mobiles has changed counties. KL7 and KH6 are considered DX and maritime mobiles are considered fixed stations for scoring purposes.

EXCHANGE:
RS(T), county and state (country for DX). Mixed mode contacts are permitted, but at least one station must be on SSB.

FREQUENCIES:
Suggested frequencies are plus or minus 10 kHz of following: 3.935, 7.240, 14.290, 21.390, 28.580 MHz. No credit for contacts on county hunter net frequencies of 3.943, 7.238, or 14.336 MHz is allowed.

SCORING:
Contact with fixed US or Canadian station = 1 point; contact with DX stations = 5 points; contact with a mobile station = 10 points. The multiplier is the total number of US counties plus Canadian stations worked. Take credit for a county only the first time it is worked. A county does not count again even if worked again on a different band, but a Canadian station counts each time it is worked. The final score is then the total number of QSO points times the total multiplier.

LOGS:
Logs should include the date and time, the station worked, the report exchanged, county, state, band, claimed points (1, 5 or 10), and each new multiplier should be numbered. Check sheets are not required but would be appreciated on all scores over 100,000 points. Summary and log sheets are available free for a #10 SASE or SAE and appropriate IRCs from: James L. Willingham KØARS, Route 1, Bevier MO 63532. All entries should be received by KØARS by June 1, 1976 to be eligible for awards. DX entries should use air mail.

AWARDS:
Plaques will be awarded to the highest scoring fixed US or Canadian station, DX station, and first and second highest scoring mobile stations. Certificates will be given to the top 10 mobile and fixed stations in the USA and Canada, and to the highest scoring station in each DXCC country. Only single operator stations are eligible for awards; multi-operator certificates will be awarded as merited. A station may enter as both fixed and mobile, but with separate scores. Winners will be announced in the MARAC Newsletter and at the 1976 Independent County Hunters Net Convention (to be held in July '76).

ZERO DISTRICT QSO PARTY
Starts: 2000 GMT
Saturday, April 17
Ends: 0200 GMT
Monday, April 19

The contest is sponsored by the TRA-ARC of Iowa State University. Stations outside of the zero district will exchange reports with stations within the zero district only. Zero district stations may work anyone. Any station may be worked once on each band, on each mode. If a mobile station changes counties, he may be worked again – so be sure to look for mobile stations changing counties.

FREQUENCIES:
3570, 7070, 14070, 21070, 28070, 3900, 7270, 14300, 21370, 28570, 3725, 7125, 21125.

EXCHANGE:
RS(T), QSO Number and ARRL section. Zero district stations will also send their county along with the ARRL section.

SCORING:
Zero district stations: Multiply the total number of contacts by the total number of different zero district counties, foreign countries, and ARRL sections. Non-zero district stations: Multiply the total number of contacts by the total number of different zero district counties worked.

ENTRIES:
To compete – logs, claimed score and SASE (for results) must be sent to: TRA-ARC, WAØTKK, B406 Wilson Hall, Ames IA 50013 no later than May 14th. Appropriate certificates will be awarded.

TWO METER ALL MODES CONTEST
Contest Period: 0300 to 0700 GMT Sunday, April 18

This contest is sponsored by the York Radio Club and Global Research and is open to all radio amateurs, worldwide. Any 2 meter contact is valid except for the use of repeaters other than OSCAR. Use all modes: SSB, CW, AM, FM, SSTV, RTTY, or FAX.

EXCHANGE:
RS(T) and state.

SCORING:
Score one point for each completed two way contact. A multiplier of 1 per mode will be given for every mode worked with a minimum of 5 contacts per mode. Example: A station working 5 contacts on AM, 5 on CW, and 5 on SSB would have a multiplier of 3. Final score is the QSO points times the final multiplier.

LOGS:
Logs should show your name, call, address, state, and input power. For each station worked, include their call, state, and RS(T) sent and received. Show your total score, sign the logs, and submit to: Phil K9DTB, c/o Global Research, PO Box 271, Lombard IL 60148. Logs should be postmarked no later than May 8th for scoring.

AWARDS:
All entries submitting logs will be listed in the YRC Circuit Board and will receive a 3 month complimentary subscription. The first place total score in each category will receive a Bicentennial certificate and a prize from Global Research. Second place totals in each category will receive the Bicentennial certificate. Categories: Mobile – any mode or power; Portable – any mode or power; High power – 100 Watts or more; Medium power – 51 to 99 Watts; Low power – 50 Watts or less; OSCAR – 2-10 meters.

Any questions concerning rules can be answered by K9DTB (Phil) at 312-279-4658. The decision of the contest committee is final.

PACC CONTEST
Starts: 1200 GMT
Saturday, April 24
Ends: 1800 GMT
Sunday, April 25

This year's contest is again sponsored by VERON in Nederland and is open to all single and multi-operator stations. Use all bands from 160 to 10 meters, but please keep the lower 10 kHz of CW bands and upper 25 kHz of phone bands free. General call is "CQ PA"; PA/PI/PE stations will call "CQ PACC."

EXCHANGE:
RS(T) and QSO number starting with 001. Dutch stations (PA/PI/PE) will also send a 2 letter code indicating their province. The possible provinces are: GR, FR, DR, OV, GD, UT, NH, ZH, ZL, NB, LB, YP.

SCORING:
Each QSO counts three points. Each station may be worked only once per band regardless of mode. Final score is the total number of QSO points times the sum of all worked provinces on each band (max 72).

AWARDS:
Certificates go to the highest scoring stations in each country and district. (A certificate will go to each call area in the US, Canada, New Zealand, Brazil, Australia, Japan, Chile, Russia and South Africa.)

LOGS:
Logs should show: date and time in GMT, station worked, QSO number sent, QSO number and province letters received, multiplier column for each band (only show a multiplier the first time it is worked), and points. Logs must be sent to VERON Contest Manager PAØDIN, PO Box 1166, Arnhem, The Nederlands, postmarked not later than June 30, 1976. Each log must be signed and indicate that the participant has observed the contest rules as well as all regulations of amateur radio in his/her country.

FOR SWLs:
Show information exchanged between PA/PI/PE station and other station. Each station heard counts 1 point; otherwise scoring is the same.

Continued on page 115

RESULTS

RESULTS OF 1975 YL-ANNIVERSARY PARTY

COMBINED SCORE (phone and CW):

CALL	POINTS	
K6DLL	5356.25	Cordoran Award
YV5CKR	4839	Hager World DX Award
WA1NXR	3796	

PHONE SCORE:

CALL	POINTS	
K6KCI	5696	Gold Cup
W2GLB	5049	Certificate
K6DLL	5232.5	Certificates
FG7XL	4746	
F5RC	3910	
WA1UVJ	3827	

CW ONLY SCORE:

CALL	POINTS	
YV5CKR	1056	Gold Cup
DKØEK	861	Certificate
DK5TT	828.75	Certificate
I3MQ	630	Certificate
DF2SL	288.75	
WA2DMK	288.75	

Note: No one qualified for the NA-Central America DX-Hager Award!

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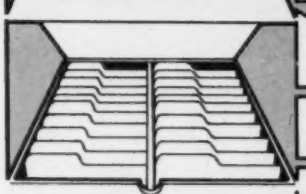

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by
Ralph Orozco, Jr. WB6FVW
2081 Bolero Avenue
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Put That AM Rig on FM

Bring the old AM rig out of retirement and put it on FM for about $10.00 or less. It's one of the cheapest ways to get on FM that I know of, especially if you already have a rig. As most of us know, with an AM transceiver, receiver slope detection can receive FM at a readability comparable with an AM signal of just about the same strength. On the other hand, in transmitting FM, an advantage is that comparatively simple means may be used to generate an FM signal.

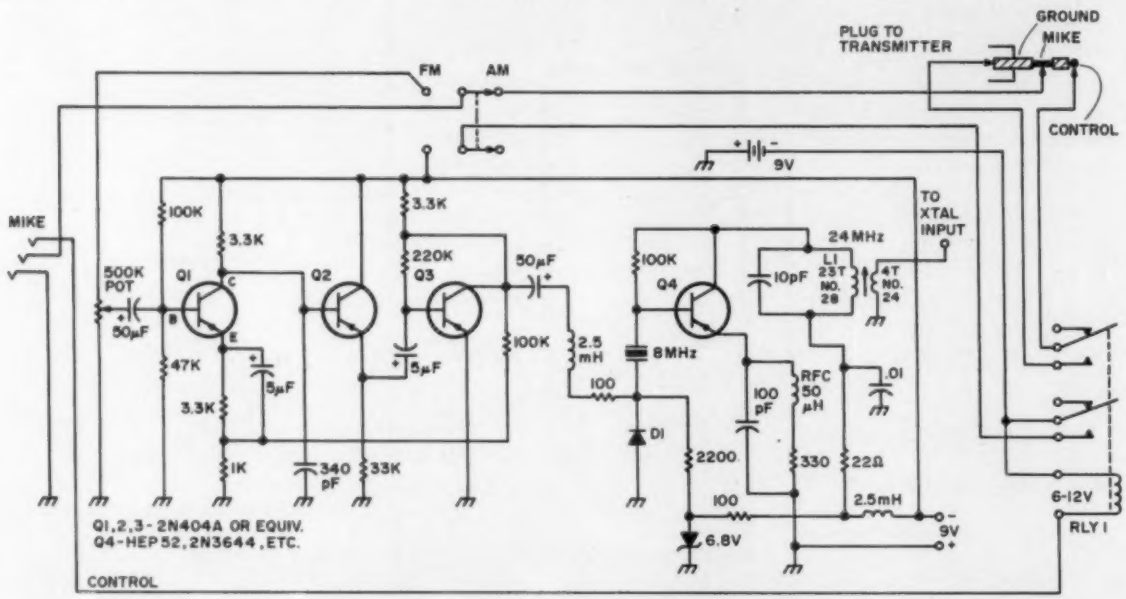


Fig. 1. Circuit of FM adaptor.

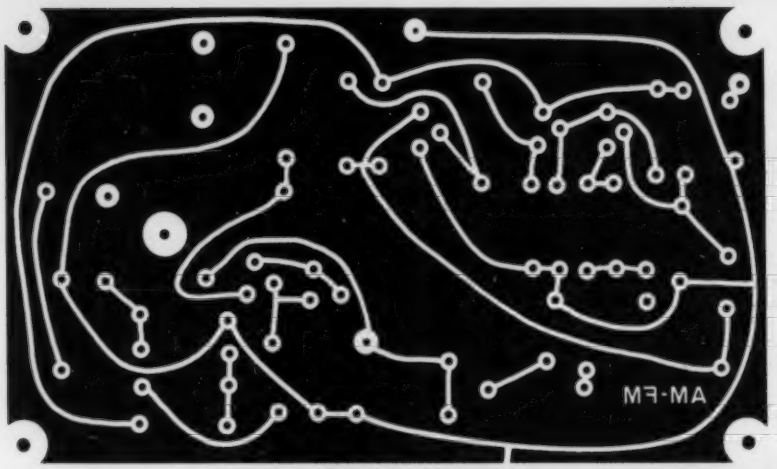


Fig. 2. PC board pattern.

Because a VHF transmitter multiplies the original oscillator frequency several times, only a small amount of deviation at the oscillator frequency will be required to produce narrow band FM. The frequency modulator contains a microphone preamplifier, driver amplifier and 8 MHz crystal oscillator at 24 MHz output. The audio from the modulator drives a variable capacitance diode in the crystal oscillator. I used a silicon switching diode. Frequency multipliers in the transmitter increase the deviation to about 8.5 kHz at the output frequency. A microphone and control with push-to-talk cable plug in the transmitter's microphone jack. It carries the push-to-talk line, but no audio unless the switch is in the AM position. Deviation can be reduced for narrow band FM by adjusting the audio pot on preamp. Use a hi-Z microphone. Results are worth it; I have been using my FM modulator 6 months, working several 2 meter repeaters and signal reports have been good. ■

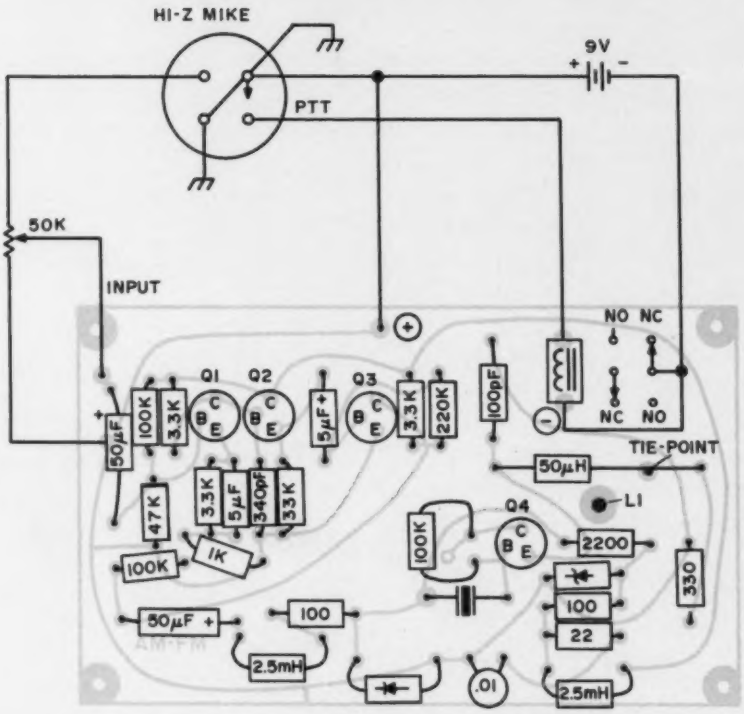
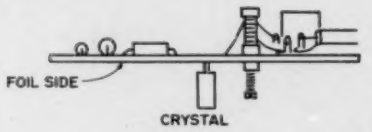
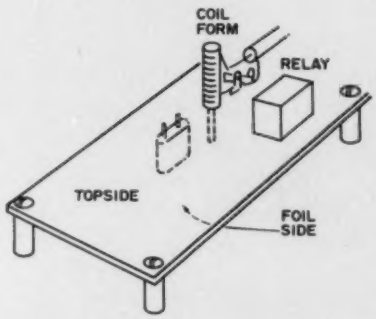
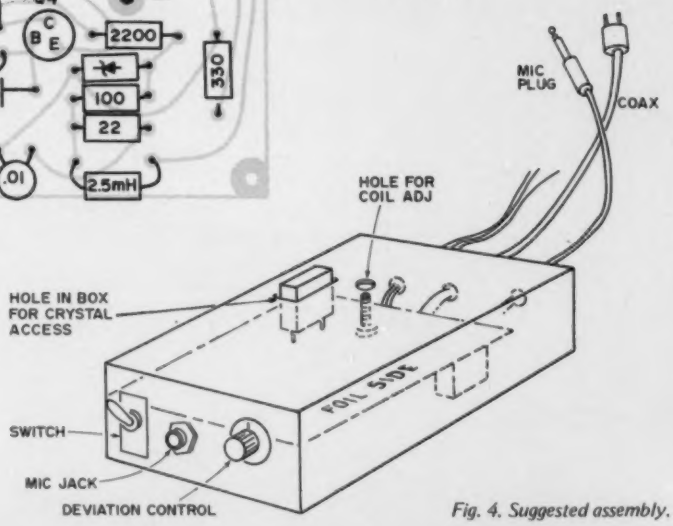


Fig. 3. PC parts layout.







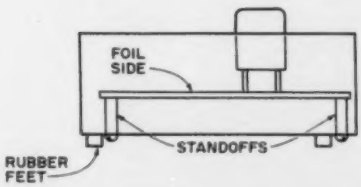


Fig. 4. Suggested assembly.

by
W. J. Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

A Carrier Operated Relay (COR) for Your Receiver

Fig. 1. Schematic of the COR. Q1 could just as well be an MPF102 or any other N channel JFET. Q2 should be a 200 mA, 30 volt transistor. RY1 is a 26 volt telephone type relay. The LED is nothing more than an indicator I hung on as an afterthought.

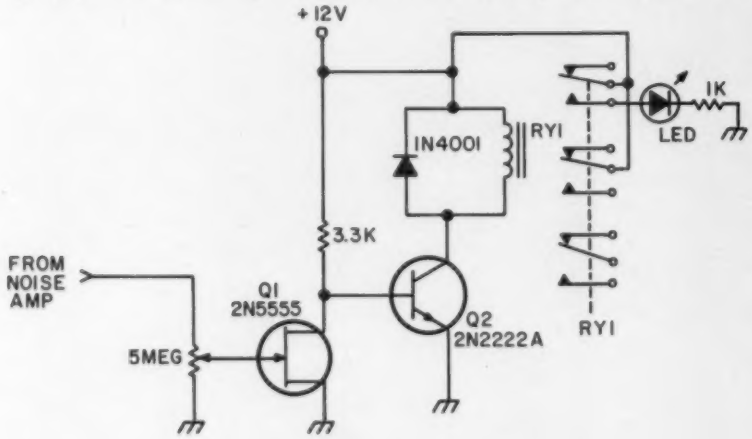
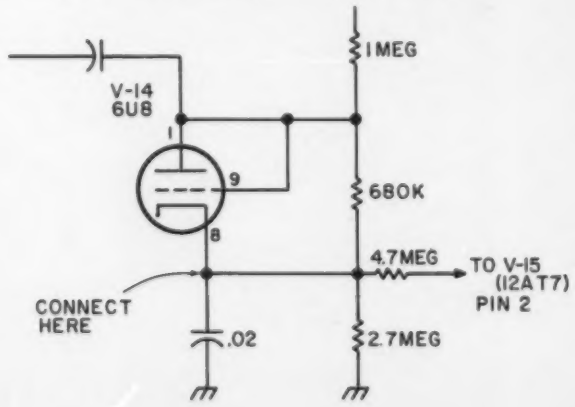


Fig. 2. Connection for a TA141A type receiver is shown.



I have a Motorola T44 which I have built power supplies for, mounted in a rack and now use as a base station. I now want to use that equipment as a 450 MHz repeater but, of course, the receiver has no COR. I could have bought a squelch relay kit made for the radio but, besides adding more tubes to the radio, it would cost money.

I retreated to my junk box and came out with a few JFETs, some NPN 300 mA transistors and a telephone type relay. The book of schematics I have for Motorola gear says the squelch relay is connected to the cathode of the noise rectifier on the 450 radios. A measurement there with a VTVM showed a voltage that rested at +2 V dc squelched and swung to about −12 V dc with a carrier present. This seemed compatible with my FETs so I put together the circuit in Fig. 1.

The cathode voltage is brought out across a 5 meg pot. The circuit starts loading and affecting squelch action when a value much below 2 meg is used. The JFET gate is taken off the arm of the pot. When the receiver is squelched, the slight positive voltage causes the FET to conduct, which in turn holds Q2 off. When a carrier is received, the gate swings negative turning Q1 off and Q2 on, thus closing relay RY1. By the way, the relay I have is marked 26 volts but I find it works fine at 12 volts and only draws about 40 mA.

Conclusion

This circuit is perfect for all of you who like to correct, improve, or add to magazine circuits. There are hundreds of ways this could be improved or modified but I wanted it simple, cheap and workable and this fits those needs admirably.

For those of you with T44s, I include Fig. 2 which shows where to hook up the COR. ■

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by
Ian Burn VE6OB
16016 78th Avenue
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A $5 100 Watt Amplifier

Over the past few months there have been two antenna-building workshops sponsored by the Northern Alberta Radio Club in Edmonton. At each workshop 15 two meter beams were constructed. The spacing and element lengths are fairly standard, but the construction methods might be unique. The original intent was to construct a small beam that could be easily disassembled for portable use; however, a number of fellows required a simple base station antenna, so materials and methods were chosen to suit both needs. The following outlines the materials and methods used.

Materials

The boom is constructed from 1/2" Type M (very thin wall) copper tubing, at least 48 inches long. A piece 6" to 8" longer would be required for ideal mounting methods, to be discussed later.

The elements are made of 1/8" diameter brass rod. This is relatively expensive, about 15¢ per foot, but the amounts required are not excessive. The element lengths are 40", 38", 36" and 35-1/2".

The gamma match is made of a 4-3/4" length of 1/16" diameter brass brazing rod (or copper), a 10 or 12 mmfd disk ceramic capacitor (12 preferred), a removable shorting clamp of your design, and a small stainless steel worm gear hose clamp.

RG58 coaxial cable is recommended if the antenna is for portable use.

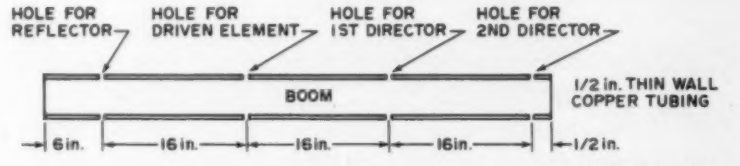

Fig. 1.

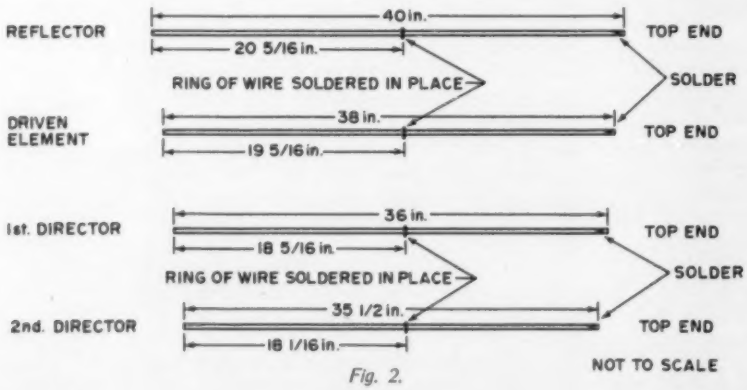

Fig. 2.

Construction

The boom is prepared by drilling 1/8" diameter holes on 16" centers. This can be accomplished by careful use of a drill press or by a hand drill. Since most workshops do not have a drill press, the second method is described.

First, draw or scribe a circle around the tubing at each of the four element positions, i.e., on 16" centers as shown in Fig. 1. A tubing cutter, used with care, will do a good job. Alternatively, wrap a sheet of paper carefully around the tubing so that it doesn't spiral and the edge will form an accurate guide for your pencil.

Once all four lines have been drawn, lay a straight edge on the top of the tubing and using a center punch, mark the 4 hole locations. These 4 holes can now be drilled but DO NOT DRILL THROUGH BOTH SIDES OF THE PIPE.

Again, with reasonable care, mark the holes on the bottom side of the tubing using a straight edge. Drill 4 holes. With a minimum amount of luck these holes will line up with the first set!

The elements should be cut to the lengths shown in Fig. 2, and a small piece of wire wrapped around and soldered to each element as shown. This is required to keep them from falling through. For permanent installation the elements may be soldered to the boom. (I have used the "gravity system" on my base station antenna for the past year with good results.) A spot of solder on the top of each element ensures that they are put in the right way up. Note that the wire ring is *not* in the middle of the elements. When disassembled, the elements are stored inside the boom. Two small corks will ensure their staying put!

The gamma match is very simple as can be seen in Fig. 3. The measurements should be followed fairly closely. The shorting clamp can be made in any number of ways.

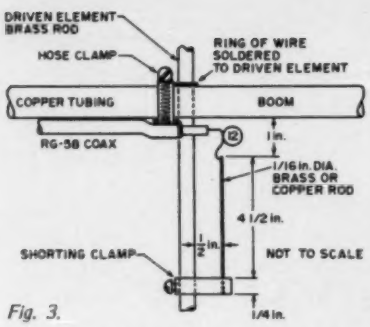

Fig. 3.

A solid block of brass can be drilled to accommodate the driven element and the gamma rod with a set screw to hold them in place. A simpler method is to fold a piece of brass or copper over both rods and place a clamping bolt in the middle. It is important to have something that can be easily loosened if the antenna is to be readily dismantled.

The hose clamp, which connects the shield of the coaxial cable to the boom, should be as close to the driven element as possible. Ideally, the cable should be dressed along the boom past the reflector and then down the support mast. A number of fellows have dropped the cable between the driven element and the first director and they report good results. Figs. 4(a) and 4(b) show the two methods with 4(a) being the preferred.

For base station operation I have fastened the boom directly to the boom of my triband beam as shown in Fig. 5.

Cost

The cost of materials should be slightly less than $5.00. If a group can get together and make 15 antennas with 48" booms (15-3/4" element spacing), this will prove to be the most economical since both copper tubing and brass rod come in 12 foot lengths. Brass brazing rod comes in 36" lengths and could be spliced up to the 40" and 38".

Test Results

At a recent two meter antenna-testing workshop, this beam provided a 10 dB gain over a reference dipole. There is no doubt in the 10 dB value, but there may be some doubt in the efficiency of the reference dipole used. In any case, the antenna works well. ■

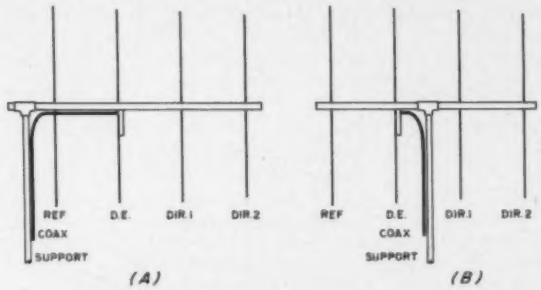

Fig. 4.

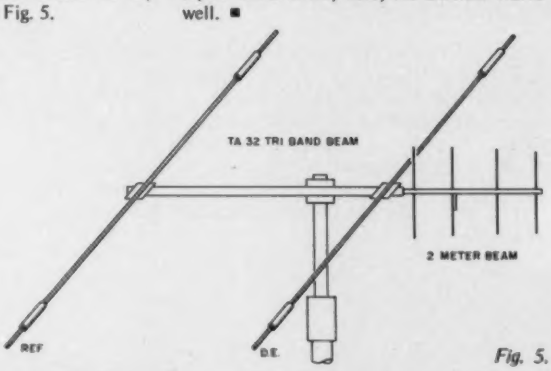

Fig. 5.

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Build A 220 MHz Repeater

One must first have a radio to build a repeater. I chose to use my Midland 220 rig. This radio is ideally suited to repeater construction as it is in three separate sections: the exciter, receiver and power amplifier. I separated the sections and then each was installed in its own aluminum chassis, except for the power amplifier, which was mounted on the rear panel of the main chassis. The chassis I'm using to house everything is a Bud AC-415, which is 17" wide, 10" deep and 2" high. The small chassis that the receiver and exciter are mounted in are 7" wide, 5" deep, and 2" high.

Some minor changes were necessary to separate the receiver from the rest of the radio as the receive crystal and trimmers are on the exciter board. This was solved by etching a small PC board and mounting the parts on it and locating it with the receiver. The channel selector switch can be eliminated along with all the parts on the exciter board that were for the receiver. The power amplifier heat sink can be removed (carefully) and discarded, as the rear panel of the main chassis makes a much better heat sink. Throw away the pilot lamps as they are current hungry, drawing over 100 mA. Without them the receiver draws about 90 mA squelched.

The power amplifier is probably the trickiest section to work with. No problems were encountered mounting it; however, it does require a little bit of tweaking to get power out of it when it's mounted. Some stretching of coils and repeaking of capacitors took care of that problem. Expect about 15 Watts or more when using a 12 volt auto battery, and up to 20 Watts with a well regulated 14 volt power supply.

At the present time I'm using what will eventually become an operating repeater as a duplex rig, on the West Hartford 220 repeater featured on the June 1975 cover of *73*.

Referring to the photograph of the top view, the enclosure on the left is the exciter board, the one on the right is the receiver board and in the center rear is the power amplifier.

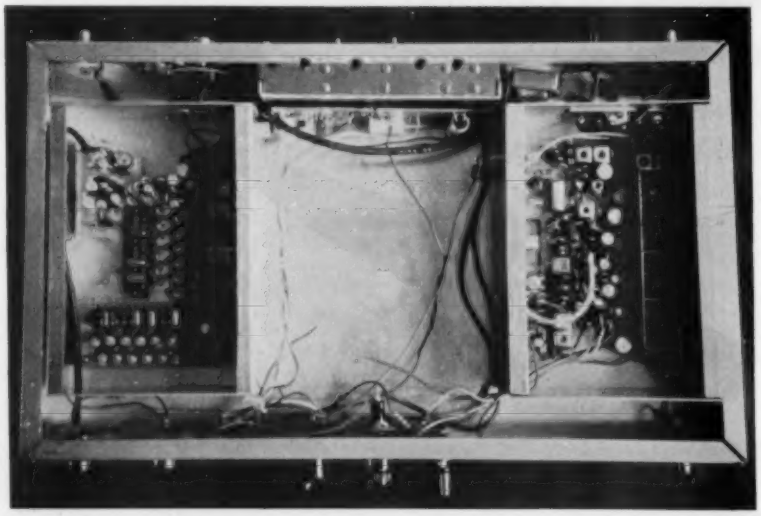
The sensitivity of the receiver is quite good as it comes from the factory, being .5 uV or better for 20 dB of quieting. Careful retuning will improve this only slightly, so a preamp seemed desirable.

I realized that finding material on the 220 MHz band is at the least difficult, and checking through a few publications confirmed this fact. I definitely wanted a preamp, so I was forced to adapt existing designs for two meters. An excellent design that can be made to work on 220 is in the *FM and Repeaters* book that the ARRL publishes. The schematic and board layout are on page 180. The coils are the only changes needed to make this preamp work quite well on 220. Change L1 to 4 turns, No. 18, 1/4" dia., 1/4" long. Do not change the tap location. L3 remains the same except for the diameter, which is 1/4".

Another change which can be done to the preamp is to reverse the foil pattern so that the parts may be mounted on the same side. Then two small pieces of double-sided PC board can be used to shield the input and output. See the 225% PC board. Tune the preamp as explained in the book.

The transmitter is as about as good a circuit I've ever seen performance-wise. Midland is definitely being modest when they claim 10 Watts output. Before I even started on this project, the rig was putting out 18 Watts at 14 V dc input, checked on a Bird Thruline. An automatic swr shutdown circuit is also incorporated in this rig, but I have bypassed it by not running the rf output on the relay board. This was so I could eliminate the eventual problems one encounters with relays by replacing it with a solid state keying circuit. I have already keyed the transmitter into an open line at high power and no damage to the finals occurred. This is probably due to the fact that Motorola power transistors are used, a 2N6081 being the final.

Since I wanted this to be a really good sounding transmitter, I also modified the modulation stage to produce true frequency modulation, rather than the phase modulation employed in the rig. This is not as hard



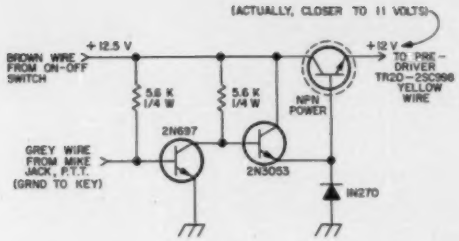


Fig. 1. Solid state transmit control for the Midland 220 repeater. Tie red wire from transmitter board (27) to B+ — this keeps the exciter operating continuously. The output from TR21 is about 100 mW, so running it all the time doesn't hurt, since the TR20 base has a 100Ω ½ W to ground to present a load. Also, the lower voltage on TR20 hasn't decreased power; I still get 15 Watts out at 12.5 volts (automobile battery).

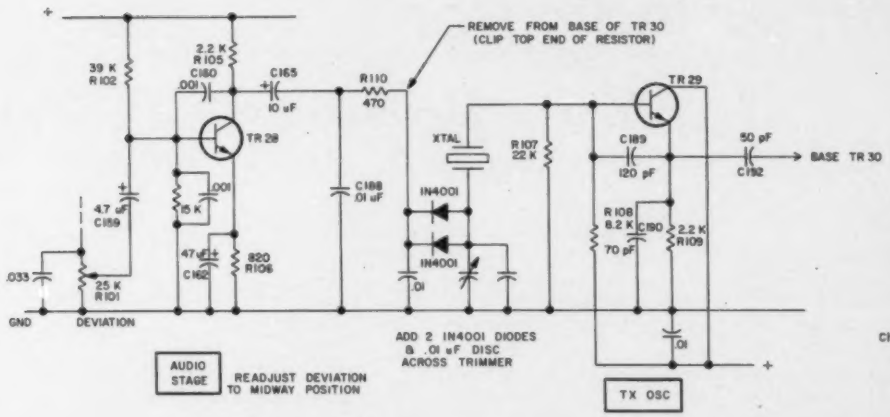


Fig. 2. Modifying the Midland 220 for true FM transmission.

to do as one would think. Since a repeater has only one transmit frequency, shortcuts can be taken. Add two 1N4001 diodes, a .01 uF disc capacitor, and clip one resistor lead and there you have it! The accompanying diagram shows where to make the changes.

I mentioned two paragraphs back that I have converted the radio to solid state keying. The circuit that I am using is also shown; parts and layout are not critical. Any NPN transistor will work, but just in case, I mounted the power transistor on the main chassis. So far it hasn't even gotten warm, even when keyed for long periods. I mounted the other parts on a piece of .1" grid perfboard and mounted the board on the back panel near the power transistor. This circuit keys the B+ to the pre-driver transistor only. The finals have B+ on them continuously. Also, I wired the exciter to operate continuously. Connecting the red wire from the exciter board at point 27 accomplishes this.

The microphone jack and accessory jack were both brought out and mounted on the front panel. The accessory jack is used to feed in the audio from my Touchtone pad. The power switch, a fuse holder, the audio and squelch controls and a 1/4" phone jack were also mounted on the front.

BNC connectors were used for the antenna connections, the chassis mount type being UG-1094s. I plan to change these to type N in the future. Number 14 insulated wire is used for the dc power leads. About six feet should be enough for any installation.

The space in the center of the transmitter and receiver is for the master logic board control circuitry, which is currently under construction. This will be presented in a future article.

If anyone would like to duplicate the layout of this project, scale drawings and additional details are available from the author. Please send a large SASE. Let's get more 220 repeaters on the air to show that we do want to keep the band. As the old saying goes, "220, USE IT OR LOSE IT." ■

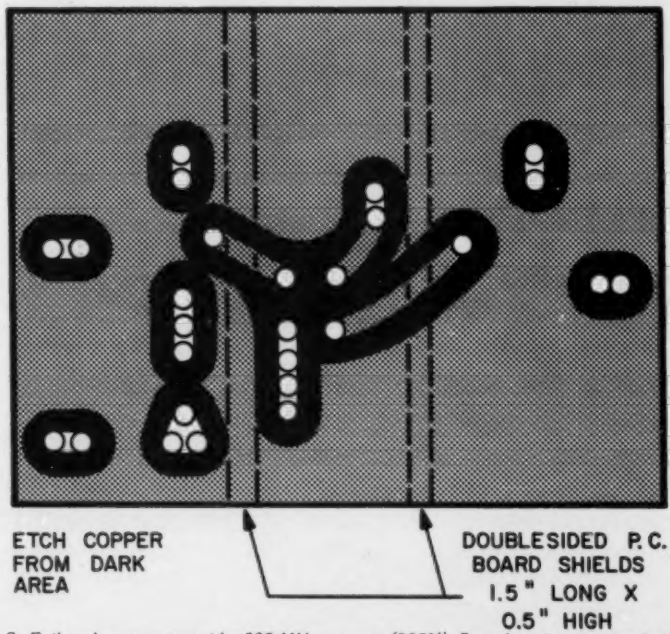


Fig. 3. Foil and component side, 220 MHz preamp (225%). Parts location same as in the FM and Repeaters *book.*

by
Fred Simonds WA1SNI
c/o *73 Magazine*

Carrier Indicator for Your Regency

In mobile and high-noise environments, it can be difficult to distinguish between carrier-off and full quieting conditions. If you have ever tried to key a repeater and heard nothing, only to hear the squelch close up a moment later, you know what I mean. Having noted (and envied) the carrier-indicator feature in Icom equipment as well as in commercial gear, I decided to see what

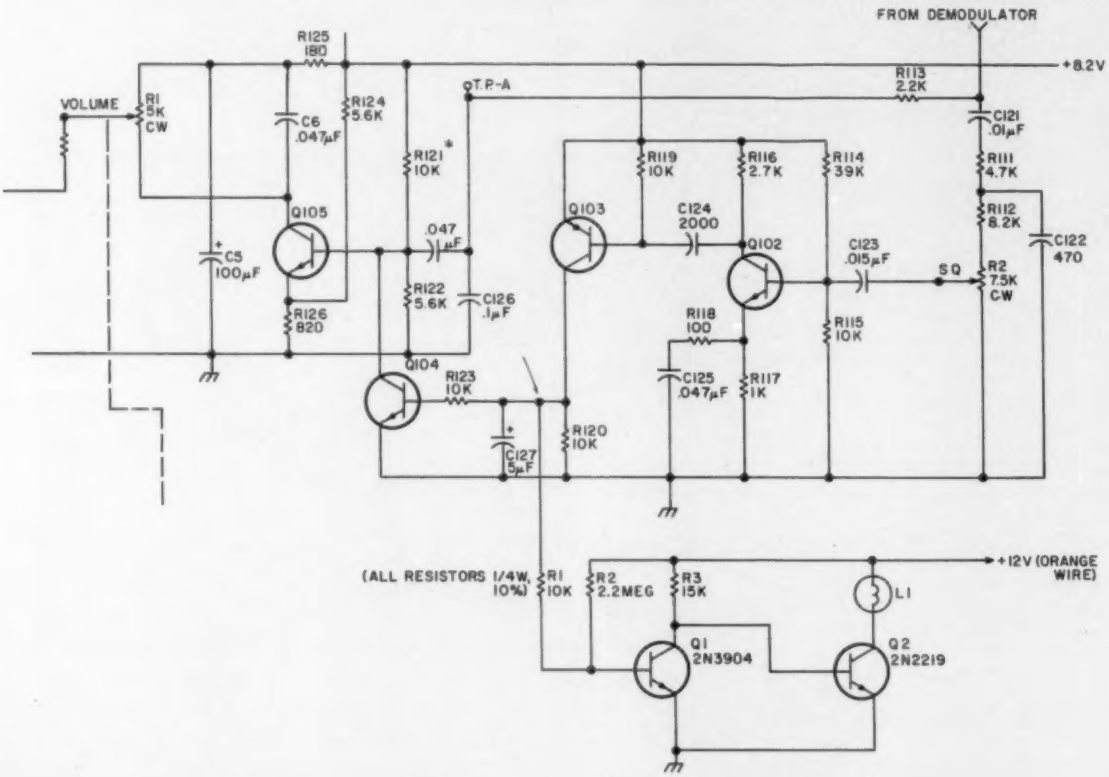


Fig. 1. Regency HR-2B squelch circuit, with inverter and lamp driver.

could be done with my Regency unit. However, this circuit is equally applicable to other rigs with similar squelch circuitry.

This modification requires no additional holes or otherwise permanent disfiguration which would reduce resale value. No etch cutting or board chopping is required. The unit may be restored to its original factory condition within a few minutes. The circuit works very well, and last but not least, it's cheap and simple!

The circuit is shown in Fig. 1. It is essentially nothing more than an inverter, Q1, and a lamp driver, Q2. A small amount of base bias is applied to Q1 to prevent low level noise spikes from turning the lamp on when no audio is heard in the speaker. Also, when Q1 is off and Q2 is on, the lamp lights fully — never at partial brilliance. This is because the biasing arrangement is such that the transistors bias themselves into saturation or cutoff with no in-between states. So even a noise spike that gets through to the speaker will illuminate the lamp momentarily. Yet the squelch control may be set at "critical squelch" and you will still have "crisp" lamp operation.

The Regency squelch circuit is quite straightforward (see Fig. 1). Demodulator noise produced during the no-signal condition is filtered and applied to a noise amplifier, Q102, through the squelch pot. The noise amplifier output is then ac coupled to dc amplifier, Q103, whose output is filtered and dc coupled to the base of transistor switch Q104. The switch simply grounds out or opens the input to the first audio stage, thus shunting noise to ground yet permitting audio to pass through to Q105.

When noise is present, it is amplified by Q102 which turns Q103 on fairly hard. Residual ac ripple is removed by filter capacitor C127. This positive dc voltage, about three volts, turns on the switch, Q104. When ac noise disappears with signal, Q103 is turned off, which in effect grounds the base of Q104, thereby turning it off and permitting audio to pass.

Since one squelch switch is already in use, why not add another one for the lamp? With proper isolation (provided by R1), squelch operation should be unaffected. However, the squelch switch is normally turned on, so an inversion is provided by taking the collector output of Q1 to drive Q2. Thus, the lamp turns on only when carrier is present. As mentioned earlier, R2 provides a small amount of base bias which the squelch signal must overcome in order to turn the lamp on. In this way, short negative-going spikes which would not be heard in the speaker will not illuminate the lamp either. Lastly, Q1 is direct-coupled to the base of Q2, whose collector load is the lamp.

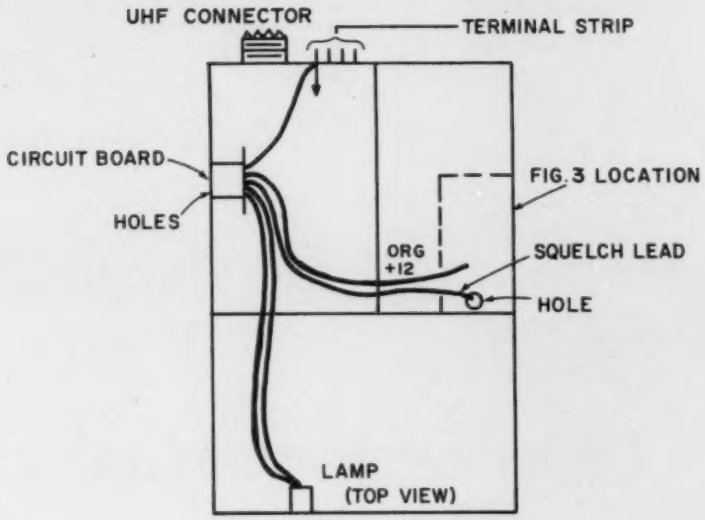


Fig. 2. Layout.

Component Selection

I had always wondered why designers select a particular transistor over another, equivalent transistor. In doing this project, I found out why. First, the devices have usually been used by the designer before, so he is familiar with their characteristics from experience. Second, they are available (in my case, junk box). Third, their general specifications (beta, collector current, power dissipation) are adequate for the task. For Q2, a low $V_{CE}(sat)$ was desirable, since I wanted the maximum voltage drop to be across the lamp, not the collector-emitter junction. R1 was chosen because it would provide both adequate isolation and base current for Q1. R2 was chosen experimentally from observing the lamp. R3 was chosen to minimize current through Q1 and to drive Q2 into cutoff or saturation. As for transistors, I simply used a good general-purpose device for Q1 and a high-current, good gain device for Q2. However, almost any NPN transistors will work, although some may require slight value adjustments in order to work well.

Installation

Since my Regency is synthesized, I don't need the channel window illumination. I removed the orange +12 volt lead from the lamp and installed a lampholder in the hole so conveniently provided by Regency. To this I connected the collector lead from Q2 on one side and +12 volts on the other side. I ran the orange lead to the left rear corner of the radio, near the UHF connector (see Fig. 2). Here I mounted the transistors and resistors on a small piece of experimental circuit board. There are two unused holes here, so I used them to mount the standoffs and then the circuit board. You may need flat washers here, since the holes are rather

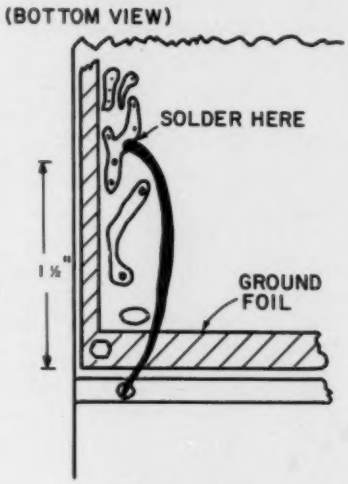


Fig. 3. Foil location detail.

large. Grounding is available at the rear apron terminal strip.

The lead for the squelch switch is provided by running a lead across the board to the foil side through a hole in the frame between the transmitter and the receiver circuit boards. Find the foil that joins R120, R123, and the positive side of C127 (see Fig. 3). Solder the lead here.

You may use the lamp originally provided for the backlight, but it turns on and off rather slowly, so I left it mounted in its clip in case I ever need to restore it to service. I used a Dialco cartridge lamp no. 39 rated at 14 V and 80 mA. Mine has a clear lens. However, the 2N2219 will dissipate .8 W and carry 800 mA, so almost any lamp will work. You could even use it to drive a COR for repeater applications! ■

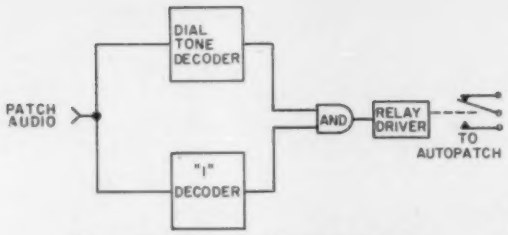


Fig. 1. Block diagram of the decoder system.

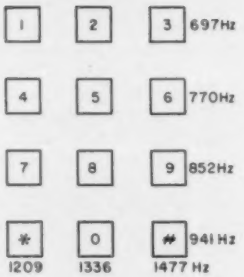


Fig. 2. Standard tone dialing frequencies.

Long Distance Call Eliminator

by
William J. Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

Our autopatch in Phoenix is an open one and anyone with a tone pad on his radio can use it. The telephone switching center that our line works through was unable to provide us with a tone dialing line without direct long distance dial capability. While this has not been a serious problem, there have been many "malicious" long distance calls, such as to time/temperature in New York City.

I wanted a simple method which would eliminate the direct dial long distance calls without doing a major rebuild of our entire autopatch. One recommendation I received was a digit counter which would allow only seven digits to be dialed. While completely feasible, the idea required more hardware and modifications to the system than I wanted to make. As I was cogitating on the situation and also monitoring the patch, I heard a guy with a marginal signal and weak tones bring up the patch and then get a misdial because his first tone digit was not strong enough to make Ma Bell's equipment function; consequently the dial tone remained until his second tone came along. It took a while to sink in, but in time I realized that the dial tone and the first digit dialed exist simultaneously for a few milliseconds. Therefore, if I decoded the dial tone with a half a second or so delay and also decoded a "1," the combination could be used to hang up the patch phone anytime a "1" was dialed as the first digit of a phone number. The idea is shown in block diagram form in Fig. 1.

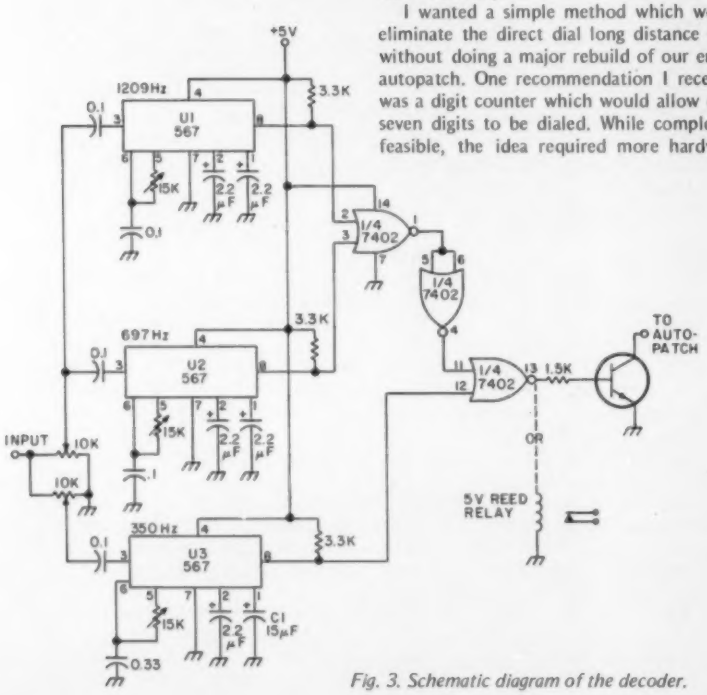


Fig. 3. Schematic diagram of the decoder.

Circuit

A quick check of my reference books showed that Ma Bell is pretty well standardized on a dual tone composed of 350 and 440 Hz for dial tones. Since both tones are well below the normal tone dialing frequencies, I decided to only decode one of the dial tone frequencies – 350 Hz. To decode the "1" I needed two more decoders, one for 1209 Hz and one for 697 Hz (see Fig. 2).

Now, referring to Fig. 1 again, when the 350 Hz dial tone and the 1209/697 "1" tone are present simultaneously, the output of the AND gate goes high thus operating either a transistor switch or a relay which in turn shuts down the patch.

The actual circuit is shown in Fig. 3 and consists of only three 567 tone decoders, a 7402 gate, and either a transistor or a relay. The decoders are connected normally for

567s except for U3 which has added capacity on the output filter. The added capacity causes the device to remain on for a few milliseconds after the dial tone has gone away. Note that C1 on U3 sets this delay and might have to be adjusted slightly to meet individual system needs.

Construction

The unit can be built almost any way you want. I found that, with minor modification, the circuit board for my Single Function Control Decoder (*73 Magazine*, March 1976) works very nicely. The boards are available from Contact, Inc., 35 W. Fairmont, Tempe AZ 85281.

Installation and Operation

First (I mean after the smoke test), using a frequency counter connected to pin 5 of U1, set the frequency to 1209 Hz. In the same manner connect the counter to U2 and adjust the frequency to 697 Hz. Then connect to U3 and adjust for 350 Hz. Now you are ready to install the device in your autopatch.

A sample of how I connected ours is shown in Fig. 4. The power source is a 309k five volt regulator connected across the 25 volt dc relay line. By the way, when using 309s don't neglect the recommended 0.22 uF from input to ground – they sometimes do strange things without that capacitor. The audio input connection is important as it must contain both telephone and receiver audio. I use the audio output from the patch to the transmitter. Then I used a transistor to open the "off" reed relay in our system as shown in Fig. 4. Another method is shown in Fig. 5 using a normally closed relay contact to open the main phone relay in a system.

As it is anytime when using 567s for decoding, they are very level sensitive. Be very careful when setting input levels – otherwise your patch might get falsed off. This is the only application right now where I have 567s in service without an agc amplifier preceding them and I may well yet add one. I hope this cuts down your phone bill – it did ours. ■

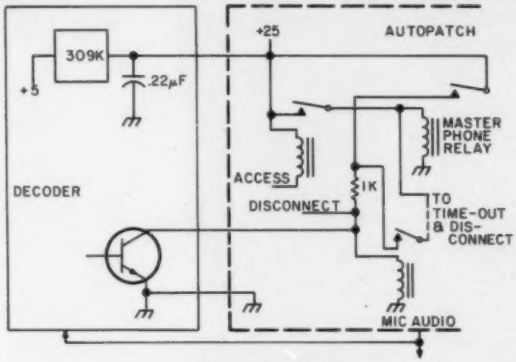


Fig. 4. Interconnection used in the WR7ABQ autopatch.

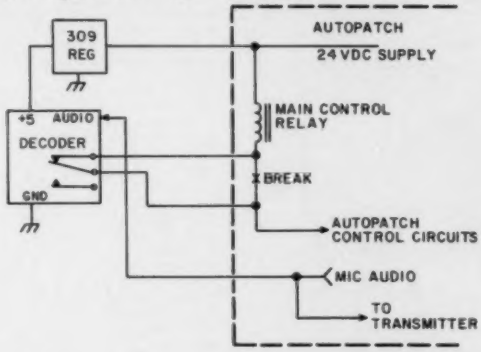
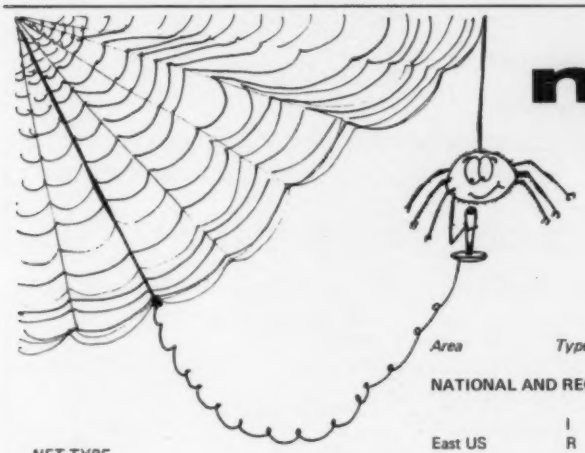


Fig. 5. Alternate interconnection using a relay having normally closed contacts.



networks

E.H. Barnett WB0IIX
Route 1
Ashland, Missouri 65010

NOTE: Times and Days are given in GMT.

NET TYPE

I – Information
R – Rag Chew
S – Service
T – Traffic

You can only get out of amateur radio what you are willing to give. Check into a net. You will make new friends who will be there when you need them! (Ever tried to raise a tower by yourself??) If you don't want to wait for a long roll call, most nets have a "Short Timer's" check-in before roll call. My thanks to WB8ESK for contributing to this month's column. If you check into a net, drop me a card and tell me about it.

Area	*Type*	*Name*	*Time*	*Days*	*Freq*
NATIONAL AND REGIONAL					
	I	Liberty Net	0300	Thurs	3995
East US	R	Old Goats Net	1200	Daily	7210
	T	Continental Traffic Net	1730	Daily	14315
STATEWIDE					
GA	T	Georgia Side Band Net	0000	Daily	3975
MO	R	Missouri Mules	1330	Daily	3963
SD	I	South Dakota Wx Net	1400	Daily	3961
WA	T	Noon Time Net	1830	Daily	3970
OH	S	Ohio Slow Net	2210	Daily	3577
OK	T	Sooner Traffic Net	2230	M–S	3850
VE3	S	Quebec Net	2245	Daily	3535
MI	I	MI AREC Net	2300	Sun	3932
VE3	T	Laurentian Net	2345	M–S	3755
LOCAL					
	T	Kent County AREC	0100	Sun	146.16/.76
	T	Orange County AREC Net	0230	Tues	146.19/.79

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by
Tom Gibson W3EAG
RD 1 Evansburg Road
Collegeville PA 19426

Repeaters in Paradise

Visitors from Capt. Cook (who discovered the islands) to James Michener have all agreed that paradise is that group of islands centered at approximately 20 degrees north latitude and 158 degrees west longitude. The Hawaiian Islands – now the State of Hawaii – certainly qualify as paradise if such can exist on this earth. Now, the Emergency Amateur Radio Club of Hawaii has constructed a "heavenly" system of two meter repeaters to add to the other attractions of this famous, historic and beautiful place.

I spent the last two weeks of June vacationing on the island of Oahu at Waikiki Beach, and having heard that two meter repeaters were available in the fiftieth state, I took my trusty TR-22 along. Much to my surprise I was able to work from Kauai to Hawaii Island from Waikiki by accessing the Diamond Head repeater.

The secret of the Hawaiian system is a series of 450 MHz links which interconnect the repeaters on Oahu, Maui and Hawaii islands. This means that a station accessing the major repeater on his particular island is also able to access the major repeaters on the other two islands via 450 links, simultaneously. The interconnection scheme is shown in Fig. 1.

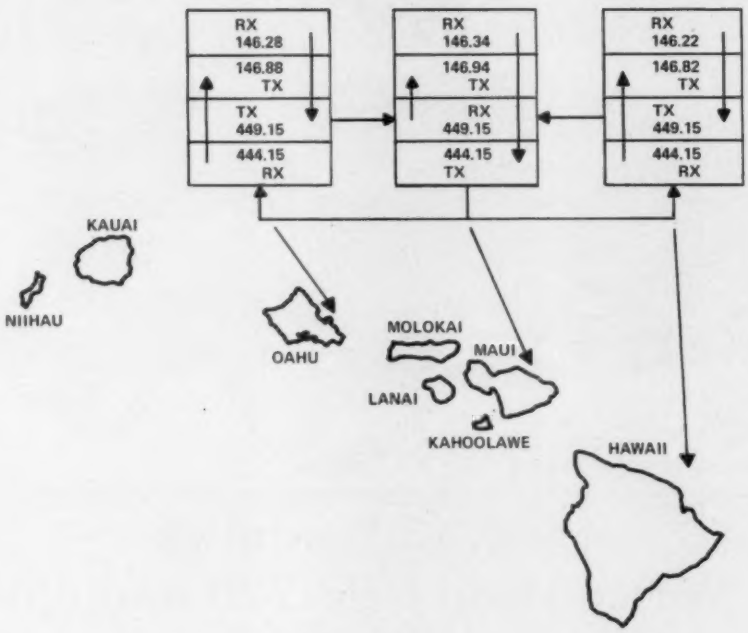


Fig. 1. Repeater link interconnection.

The Diamond Head repeater operates from the crater rim of that famous landmark on a frequency pair of 146.28/146.88 MHz. This is the major repeater for the island of Oahu and is linked to the other islands by the 450 MHz links previously mentioned. There is also a local repeater operating at 146.16/146.76 MHz at the University of Hawaii Manoa Campus but this may be discontinued due to lack of activity. We could hope not as it is a very nice repeater and easily accessible from the Waikiki area. There is another local repeater on the western side of Oahu at Ewa which operates on 146.19/146.79 MHz. This repeater is not easily accessed from Waikiki with a handie-talkie, but there are plans to move it to a much higher point in the Waianae mountains approximately 4000 feet above sea level. This should improve access considerably.

The major repeater on the island of Maui is located on an extinct volcano, Haleakala, at 10,000 feet above sea level. Haleakala means "house of the sun" and with that kind of elevation we won't argue the point. The frequency pair for the Haleakala repeater is 146.34/146.94 MHz. The location is so good that it provides an input for base stations on Kauai some 200 miles away. I was able to access it with the handie-talkie from a twelfth floor balcony on Waikiki beach, a distance of a little more than a hundred miles.

The "Big Island" of Hawaii is the site of a 146.22/146.82 MHz repeater.

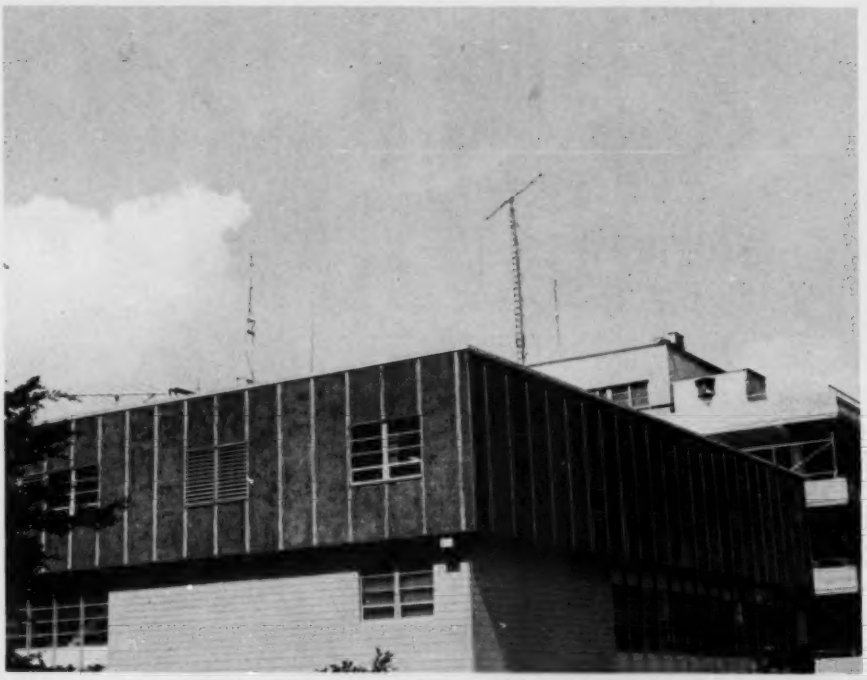
This is located on Mauna Loa, an active volcano, at approximately 8,000 feet MSL. This is the only two meter repeater operating from an active volcano (it has erupted since my visit), and probably holds a DX record for access as well having been worked from the west coast during a band opening – a distance of some 3000 miles. There is a local repeater at Hilo using 146.16/146.76 MHz for operation.

At present, there is no repeater on the island of Kauai, but plans are being made for a 146.04/146.64 MHz machine there to link with the other islands, and a local repeater on 146.13/146.73 MHz according to John KH6BFU at Hanamaulu, Kauai.

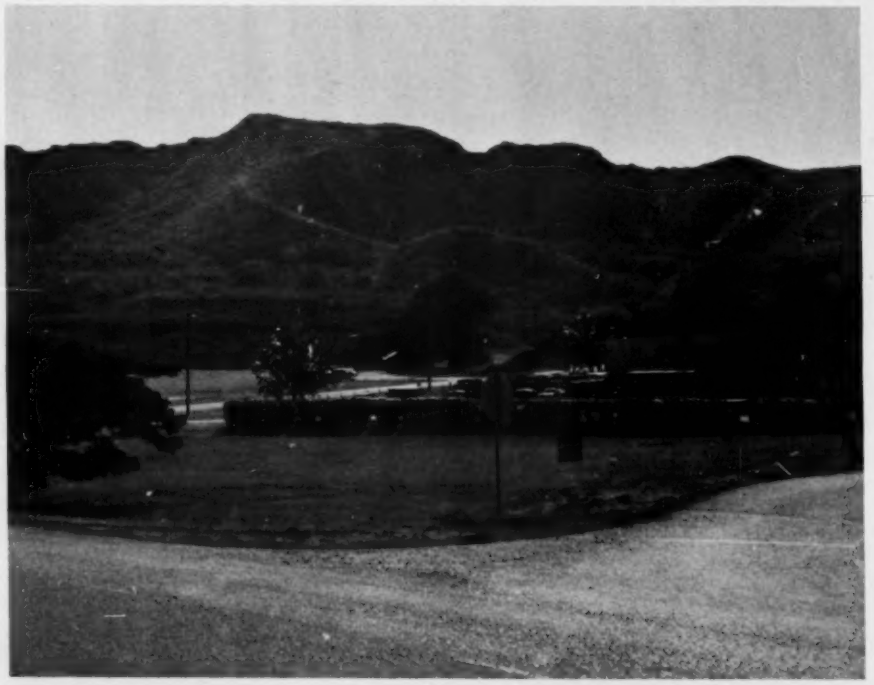
It is interesting to note that the ancient and honorable tradition of calling CQ is being preserved in Hawaii. Whereas mainland operators routinely say "monitoring 76" or "listening 88" to indicate their availability for a call, you will still hear "KH6 - - - calling CQ Diamond Head," etc. Some KH6 stations have switched to the mainland type operation, but many still call CQ, so don't be afraid to do likewise.

In spite of the re-transmission necessary to achieve linking, the audio quality is good. During my stay there the operation was consistent and reliable. It was a real thrill to sit on Waikiki Beach and yak with a fellow ham at Kona about 175 miles away using a handie-talkie. And what a fantastic communications resource in the event of an emergency! The fiftieth state should be proud of its hams.

We would like to credit KH6GBX, KH6GRQ, KH6FNB, KH6BFU and numerous others for information, consideration and abundance of the "aloha spirit" during our visit to Hawaii. ■



Shown above is the Hawaii Institute of Geophysics Building at the University of Hawaii Manoa Campus on the island of Oahu. KH6FOX operates the 16/76 repeater from this location as well as a variety of other ham gear.



This scene is inside the crater of Diamond Head looking toward the south. The 28/88 repeater antenna is located on the opposite rim of the crater.

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Simple New TT Decoder

by
William J. Hosking W7JSW
8626 E. Clarendon
Scottsdale AZ 85251

I recently had need of a simple and compact single function control circuit. I wanted it to fit in most commercial or amateur transceivers and decode two numbers from a Ma Bell tone pad. The 567 decoder fit the bill but I didn't need the full seven tones. Three tones would give me the two numbers I wanted.

Connection of the basic 567 tone decoders is right out of the Signetics Data Book. Three of the decoders are used to decode two Touchtone digits. The values shown in the schematic will allow each of the decoders to be tuned over the entire tone signaling range. With this range the decoder can be set to recognize any two numerals in a given row or column on the tone keyboard. In my particular case, I have one set to turn on with a "*" and off with a "#", and another set for "1" ON and "*" OFF.

Circuit

The circuit is shown in Fig. 1. The audio input to the decoder should not exceed about 200 mV. R1, 2 and 3 in conjunction

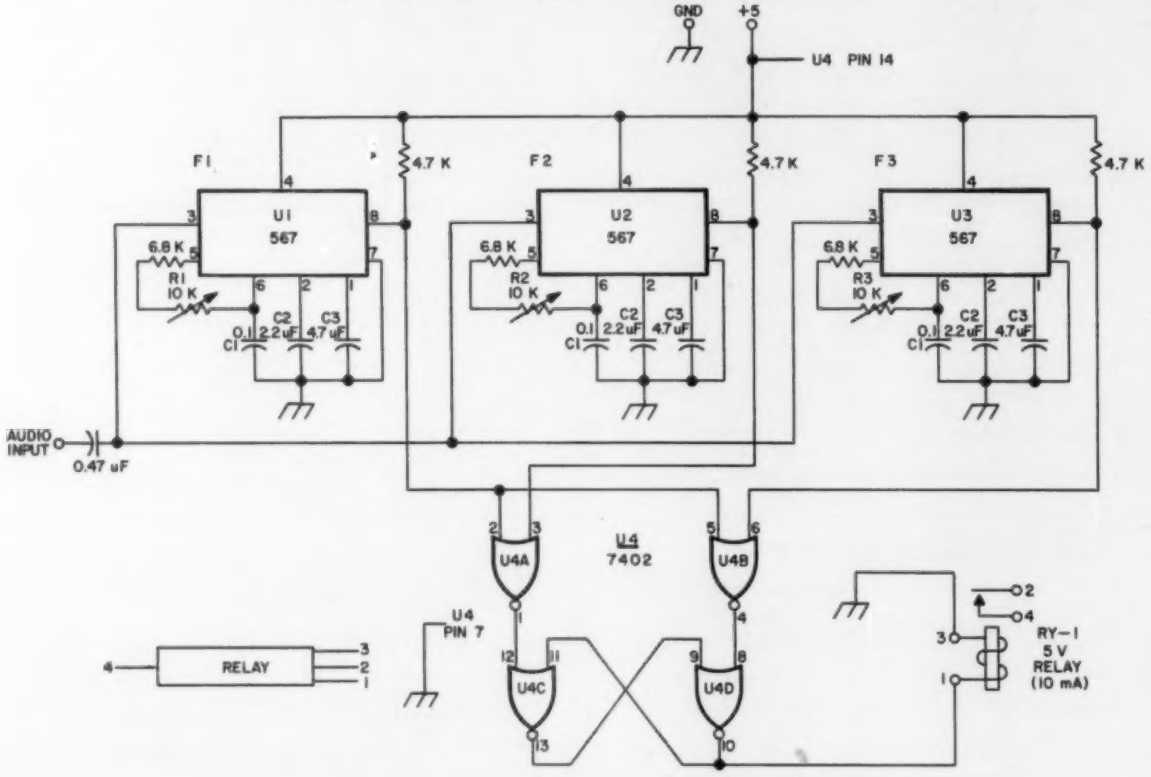
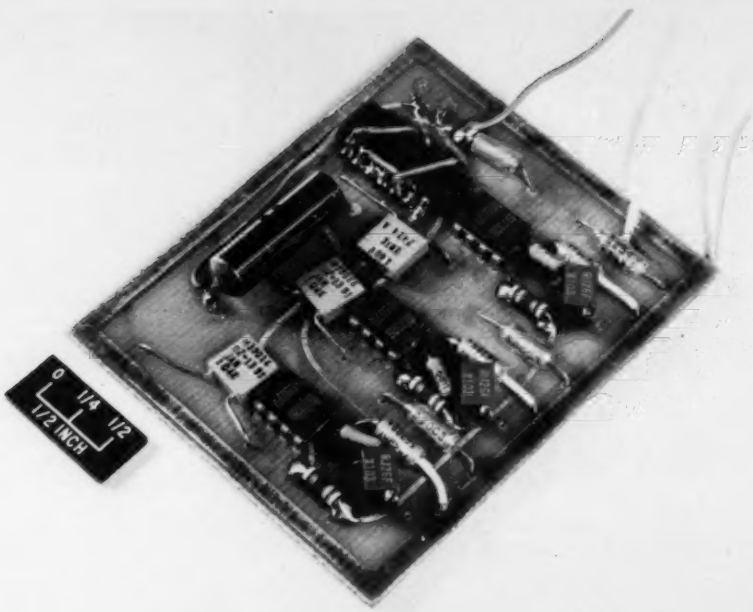


Fig. 1. The complete circuit for the function decoder. F1, F2 and F3 are the required tone frequencies for the desired control numbers. RY-1 on mine is an Electronics Applications Company IA5AH but any 5 volt SPST Reed relay will work.



An assembled prototype circuit board. The board is approximately 2½" x 3".

with C1 set the frequencies of their respective 567 decoders. With the values shown the variable resistor will tune the 567s over a range from about 550 Hz to 1500 Hz. C2 is the loop low pass filter and controls the detection bandwidth. I used the 2.2 uF value specified in the application notes and found it works fine. C3 affects the turn-on time and jitter on the output switch. With the value given in the data book I experienced considerable leading edge bounce on the 567 output. Increasing C2 to around 4 to 6 uF cut down the bounce without slowing down the turn-on too much. The output of U1 goes to both decoding gates and this IC sets the common row or column frequency for the two numbers desired. The outputs of U2 and U3 go to U4A and U4B respectively. These 567s are tuned to the frequencies of the second tone required for each numeral. The outputs of U4A and U4B set and reset a latch made up of U4C and U4D. The output of U4D drives a 5 volt low current relay directly.

Adjustment

A frequency counter or accurately calibrated scope is required to adjust the decoder. A chart of the tones is shown in Fig. 2. When the desired numerals have been selected from a single row or column (i.e., 1 and *) then tune U1 to the common tone frequency (i.e., 1209 Hz). This is done by connecting the counter to pin 5 of U1 and adjusting R1 until the desired frequency is read.

In the same manner adjust U2 and U3 to the second tone frequencies for the two numbers desired (i.e., U2 to 697 Hz and U3 to 941 Hz).

Now with a tone pad connected to the audio input and the level set to about 100 mV the relay should turn on and off with the correct tones. With the example I gave, the relay should turn on with a "1" and off with a "*".

Hz	1209	1336	1477
697	1	2	3
770	4	5	6
852	7	8	9
941	*	0	#

Fig. 2. The standard tone frequencies for tone dial systems.

Conclusion

A photo of the completed decoder in its prototype stage is included. The circuit fits my requirements and also fits inside my 450 base station. The board is approximately 2½" x 3". A local group CONTACT, INC., 35 W. Fairmont Dr., Tempe AZ 85281, has etched and drilled PC boards available for the decoder with latch and relay for $5.50. They also sell the decoder wired, tested and tuned to your desired numbers. I have several of these decoders in use in various places and find them quite useful. ■

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T-599D Specifications

FREQUENCY RANGE: 3.5-29.7 MHz
MODES: USB, LSB, CW, AM
INPUT POWER: USB, LSB, CW: 160 watts on 80 to 15 meters, 140 watts on 10 meters, AM: 80 watts on 80 to 15 meters, 60 watts on 10 meters
ANTENNA IMPEDANCE: 50 to 75 ohms, unbalanced
FREQUENCY STABILITY: 100 Hz 15 min. after warm-up
CARRIER SUPPRESSION: 40 dB
UNWANTED SIDEBAND SUPPRESSION: 40 dB
HARMONIC RADIATION: -40 dB
AF RESPONSE: 400 to 2,600 Hz (-6 dB)
KEYING: Block bias keying
AUDIO INPUT: 600 ohms or 50 kilo ohms
TUBE AND SEMICONDUCTOR COMPLEMENT: 3 tubes, 1 IC, 4 FET's, 30 transistors, 38 diodes
POWER REQUIREMENTS: 110-120/220-240 VAC, 50/60 Hz, 350 watts
DIMENSIONS: 270 W x 140 H x 310 D (mm)
WEIGHT: 12.5 kg
PRICE: $479.00

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R-599D

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*with optional converter
MODES: USB, LSB, CW, AM, FM
ANTENNA IMPEDANCE: 50 to 75 ohms, unbalanced
FREQUENCY STABILITY: 100 Hz per 15 min. after warm-up
SENSITIVITY: USB, LSB, CW: 0.5 μV for 10 dB (S+N)/N on 160 to 10 meter band, 1.0 μV for 10 dB (S+N)/N on 6 and 2 meter bands. AM: 3.0 μV for 10 dB (S+N)/N on 160 to 10 meter bands, 6.0 μV for 10 dB (S+N)/N on 6 and 2 meter bands. FM: 3.0 μV for 20 dB (S+N)/N on 10 meter band, 5.0 μV for 20 dB (S+N)/N on 6 and 2 meter bands
SELECTIVITY: USB, LSB: 2.2 kHz (-6 dB), 4.4 kHz (-60 dB). CW: 0.5 kHz (-6 dB), 1.5 kHz (-60 dB). AM: 5.0 kHz (-6 dB), 12.0 kHz (-60 dB). FM: 20.0 kHz (-6 dB), 120.0 kHz (-40 dB), 14.0 kHz (-6 dB)*, 40.0 kHz (-50 dB)*
*with optional FM filter
IMAGE RATIO: 50 dB
IF REJECTION: 50 dB
AF OUTPUT POWER: 1 watt
AF OUTPUT IMPEDANCE: 4 to 16 ohms
SEMICONDUCTOR COMPLEMENT: 2 IC's, 10 FET's, 34 transistors, 59 diodes
POWER REQUIREMENTS: 100/117/220/240 VAC, 50/60 Hz, 15 watts or 13.8 VDC, 1A
DIMENSIONS: 270 W x 140 H x 310 D (mm)
WEIGHT: 5.7 kg
PRICE: $459.00

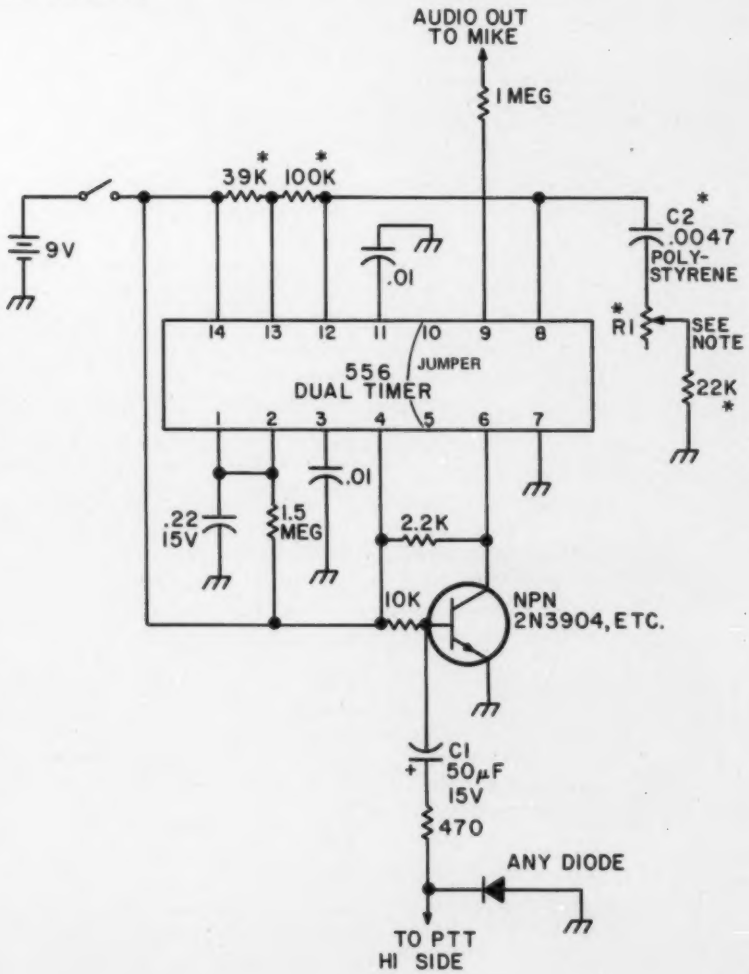
S-599

FREQUENCY RESPONSE: 100 to 5,000 Hz
IMPEDANCE: 8 ohms
DIAMETER: 12 cm
INPUT POWER: 2 watts
DIMENSIONS: 150 W x 140 H x 185 D (mm)
WEIGHT: 1.5 kg
PRICE: $19.95

Specifications and prices are subject to change without notice.

One IC Tone Burster

*Fig. 1. R1:15 or 20 turn linear 10k trimmer (Amphenol 3805, etc.). *Cermet or wirewound resistors.*



by
Lhary Meyer WB6ZUA
Box 379
Fairfax CA 94930

Needing an 1800 Hz tone burst to access a local repeater, I turned to my faithful junk box. The most likely prospect was a 556 IC dual timer that I got as a free sample from a manufacturer (a great way to get 1 or 2 pieces of a part free, especially if you have a letterhead).

The first half of the IC is used as a monostable with an on time of about 400 ms. The second half is a free running oscillator which is disabled via the low output of timer #1. The NPN transistor amplifies the negative going pulse from C1 to start the cycle when it discharges to ground.

The only part that is not common is the 15 or 20 turn trimmer pot. These run about $2.50 new from Allied and allow a smooth, stable frequency setting. They produce about a 30 Hz per turn tuning and have a low tempco.

The input voltage and the temperature have little effect on the frequency, but if your repeater has a narrow window the parts should be cermet or wirewound resistors and a polystyrene capacitor. The power for the circuit is not critical. I use a 9 V battery, but 12 V is fine. The trigger input requires +12 V.

Mine is mounted in a small minibox with a male and female mike connector on opposite sides. I included a power switch and with only 11 mA drawn, the batteries last a long time. A switch and a few more pots would give various tones if you need them. ■

The Tuna-Two Traveler

by
Edward R. Spadoni W1RHN
91 Tower Street
Dedham MA 02026

Are you using your 2 meter FM mobile transceiver with battery or ac power supply at the home QTH? Want to move it temporarily away from its present location to the den, without having to reroute the outside antenna? You may want to try it in the living room or bedroom when you're ill or want to be super comfortable, or on the porch or patio on a nice Sunday afternoon. Operate from your motel room after a long drive, whether vacationing or on a business trip. The portable antenna to be described will also give you freedom to find a comfortable spot to operate the rig and still allow you to locate the antenna for best results.

Description

The antenna described here has been used at all of the above-mentioned places, with surprising results. The design and construction was due to the desire for a small, quick to assemble, easy to move around (i.e., looking for a hot spot in a room) type antenna, that can be remotely located from the rig, limited only by the transmission line used. The radiation resistance of a ¼ λ antenna is in the order of 20-30 Ohms under favorable conditions. Most 2 meter FM transceivers want to see approximately 50 Ohms for a load. To help the antenna meet this requirement I introduced a ¼ λ,

RG-58U (53 Ohms) matching section. The transmission line between the transceiver and the antenna can be any reasonable length of RG-59U (73 Ohms) TV type coaxial cable.

Construction

Obtain a tuna fish can or equivalent (approximately 7 ounces), wash well, remove label and drill holes (see Fig. 1). Because the metal is on the thin side, be careful of sharp edges and burrs. Use a 5/8 inch (16 mm) Greenlee punch to make the mounting hole for the coaxial connector. Any telescoping section that will extend between 16 (40 cm) through 25 (63 cm) inches will work. The telescoping section that I used came from an old set of TV rabbit ears. A coupler is needed that becomes part of the telescoping section and is screwed onto the threaded stud of the insulated feedthrough. The coupler was made from 3/8 inch (9.5 mm) diameter aluminum rod. One end is drilled to accept the telescoping section. The other end is drilled and threaded to match the stud on the feedthrough insulator used (see Fig. 2).

Assembly

Most parts came from the junk box, others from the local radio-TV parts store (see Fig. 3 for assembly, and parts list). A replacement CB walkie-talkie antenna from the Radio Shack, catalog no. 21-1156, can be used for the telescoping section. Install the feedthrough insulator onto the can as shown, then the SO-239 coaxial connector with ground lug and associated hardware. The hardware used was 4-40 thread by 5/16 inch (7.9 mm) long screws with lockwashers and hex nuts. Next, make the matching section from RG-58U cable (see Fig. 3). Shape into a coil that will fit inside the can and tape at several places (see photo). Now install inside the can and solder ends of cable to the lugs and coaxial connector. I found a plastic cover of the right size that will fit over the bottom of the can to prevent scratching of furniture, etc. It came with a can of peanuts, a well-known brand and found in most supermarkets.

Final Comments

The transceiver used with the antenna is an Icom IC-20 with approximately 10 Watts output. After attaching the antenna to the rig, I placed the antenna on the hutch in the den, extended the telescoping section to about 19 inches (48 cm) and fired up the rig. The IC-20 has a relative power output meter with a mark that lets you know if you're in the ball park for a 50 Ohm match (this was checked using a known load). The meter indicated that there was a mismatch. By adjusting the length of the antenna, I was able to bring the meter within the proper range. I then tried the antenna on the window sill; this did cause the match to change, but again with a little adjustment

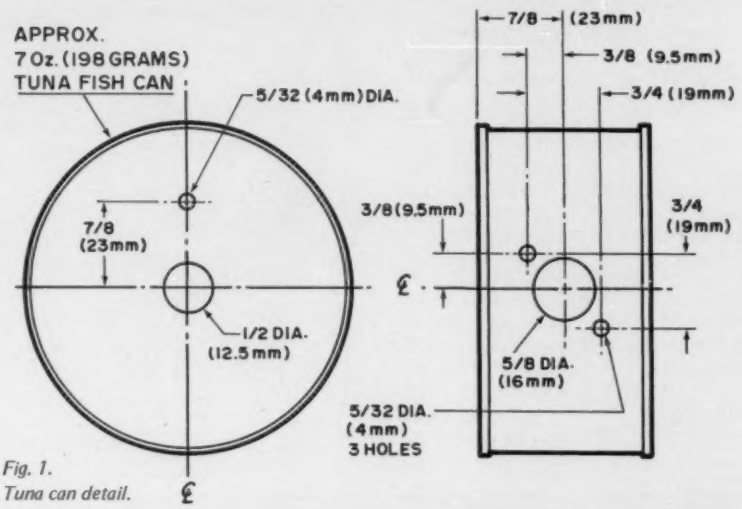


Fig. 1. Tuna can detail.

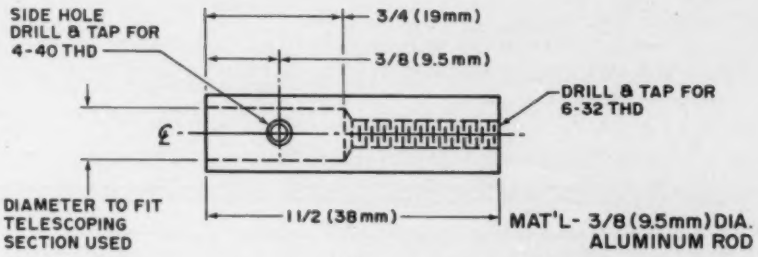

SIDE HOLE DRILL & TAP FOR 4-40 THD
3/4 (19mm)
3/8 (9.5mm)
DRILL & TAP FOR 6-32 THD
DIAMETER TO FIT TELESCOPING SECTION USED
1 1/2 (38mm)
MAT'L- 3/8 (9.5mm) DIA. ALUMINUM ROD

Fig. 2. Coupler.

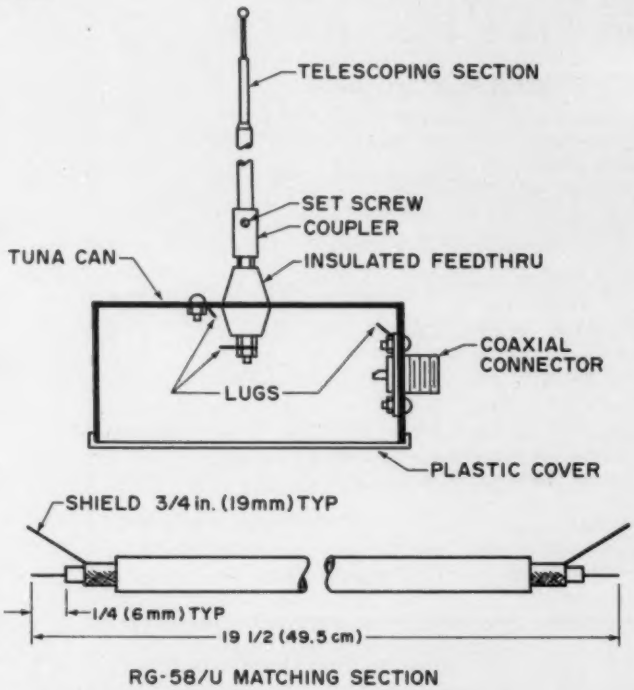


Fig. 3. Assembly. Center conductor is soldered to feedthrough lug and coax connector center.

and watching the meter, the mark was reached. I want to note that when the antenna was not operating at optimum setting, repeater and simplex contacts were being made with good results, indicating that it is not a critical adjustment. Most transceivers today have their output transistor stage protected against antenna troubles that may develop (check owner's manual). I connected a Heathkit VHF swr meter into the circuit with the antenna located on the window sill and found that from 146 through 147.69 MHz the swr was less than 1.5:1. With the antenna located on the sill I have been able to work through 5 repeaters in and around the Boston area including Derry, New Hampshire (WR1ABQ rpt.)

located about 50 miles away. QSOs up to 25 miles have been made via simplex. This antenna is a good evening or weekend project. Its low cost and ease of assembly will make it worth your while to use or have available if needed. ■

Parts List

QTY	Description
1	Tuna can (refer to Fig. 1)
1	Feedthrough insulator – E.F. Johnson, cat. no. 135-50 (or equivalent)
1	Coaxial connector, type SO-239
1	Telescoping section (refer to text)
3	No. 4 – ground lugs
1	Plastic cover (refer to text)
1	Coupler (refer to Fig. 2)
1	Set screw (4-40 x 1/8" long)

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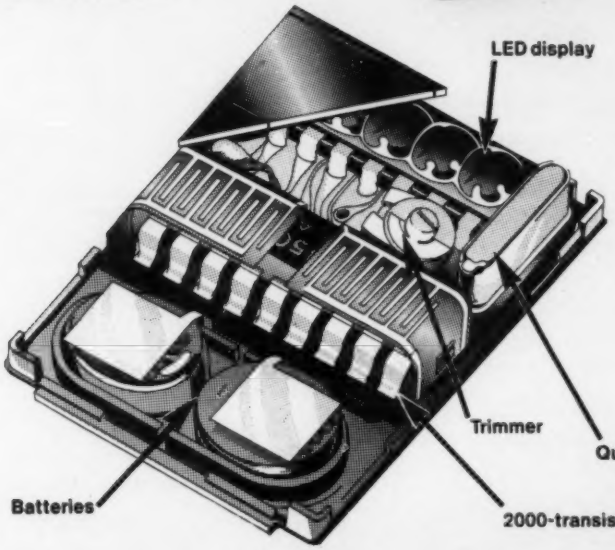

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The Mighty TR-22/15

by
Walter W. Pinner WB4MYL
7304 Lorenzo Lane
Louisville KY 40228

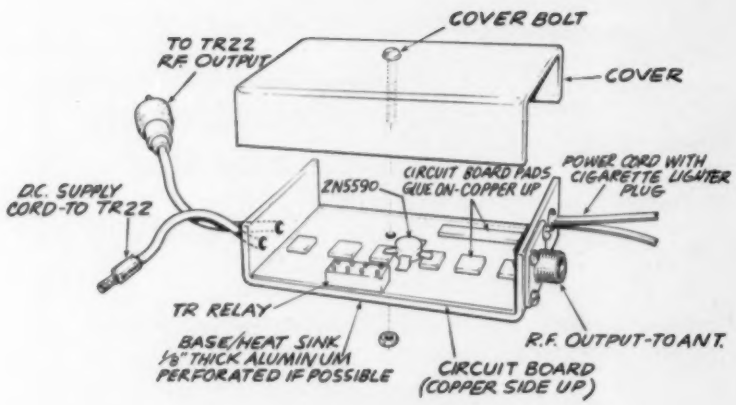
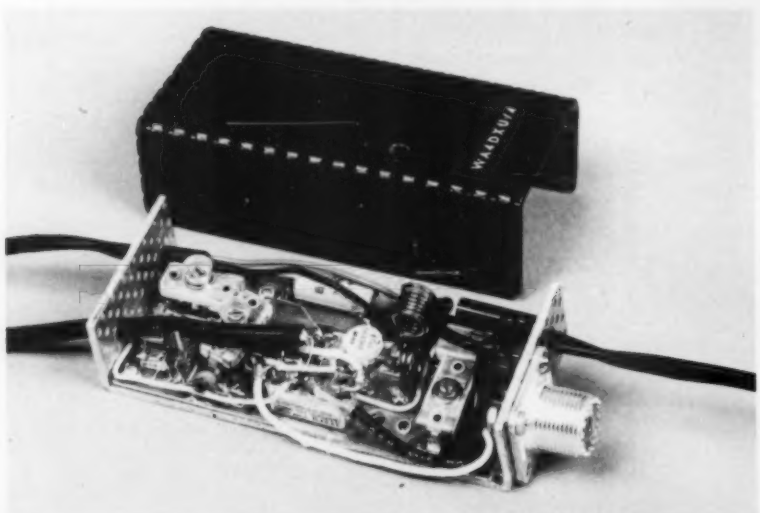


Fig. 1.



Want to add a little more power to your TR22??? Want to make this power package small enough to fit into the microphone pocket??? Want to make the circuit board with tin snips and glue??? YES? Read on . . .

The little amplifier I'll describe is easily constructed, will deliver 15 Watts output with 1 Watt input and can be built for less than $10.00.

The amp fits into the mike pocket of the TR22C nicely and incorporates a dc power plug for the radio. A small 1 inch slit in the mike pocket bottom allows the dc plug and rf input plug to go directly to the sockets on the bottom of the transceiver. The top of the amp has the antenna socket and dc input cable fitted with a cigarette plug. This arrangement provides easy hookup to your car, boat, motorcycle or ??? and when used mobile, both the TR22 and the amp are powered by the external source.

Fig. 1 shows the mechanical construction. An aluminum bottom/heat sink is formed as shown. A piece of copper clad board is pop-riveted or bolted to the bottom cover, copper side up. An aluminum top is formed and secured to the finished amp with a single through bolt. The circuit board is made by cutting copper clad pads with tin snips and gluing with one drop super glue or epoxy as shown in the full size layout in Fig. 2. Fig. 2 also shows the parts placement. All leads

should be cut to the minimum needed length including the compression trimmer caps. Fig. 3 shows the schematic and parts list. The rf transistor has been advertised in *73* at $6.00. Heat sink paste should be used when mounting this transistor and don't get too strong when tightening the mounting nut. Tuneup is simply a matter of connecting the amp to a dummy load or antenna through an output indicator, apply drive and tune C1, C2, C3, C4, in that order for maximum rf output. These adjustments will interact; therefore, the procedure should be repeated several times until no further increase in output can be obtained.

Several units constructed all produced 15 plus Watts out and provided that little extra power needed when you decide to throw the TR22 on the seat next to you and go mobile.

I want to thank Roy WA4DXU for the use of his rig for photography. Mine wasn't painted pretty. ■

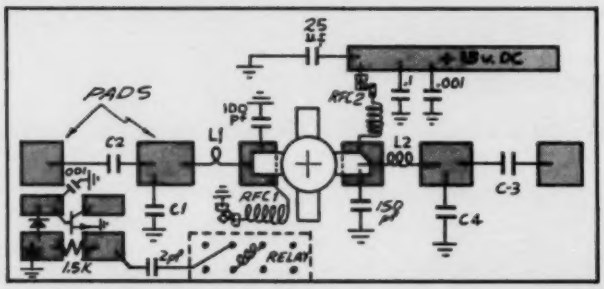


Fig. 2.

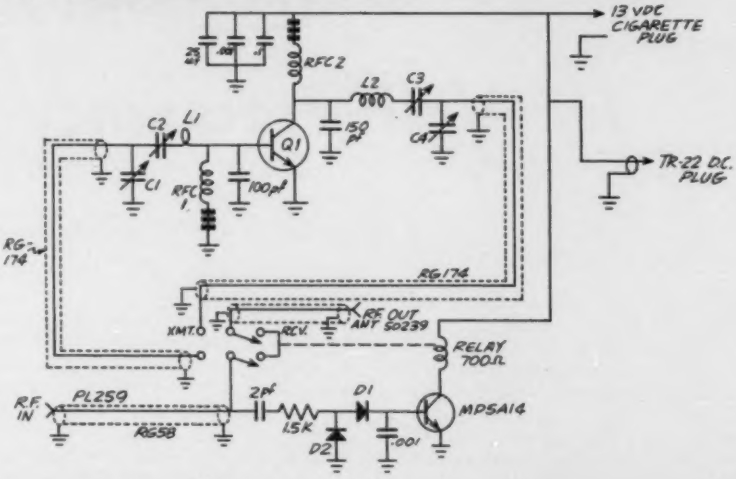


Fig. 3. Schematic. Q1 – 2N5590 or 2N6081; L1 – 1 turn #18 wire 8 mm dia.; L2 – 3 turns #18 wire 8 mm dia.; RFC 1 & 2 – 8 turns #18 wire 8 mm dia. with 3 ferrite beads on the cold end; Relay – 2P2T sigma ½ xtal can 12 V dc or similar (Poly Paks #92CU1743, 12 for $1.00, 26 V dc 700 Ohm, work on 12 V dc or higher); C1, C4 – 15 to 150 pF (Poly Paks #92CU1979, assortment 20 for $1.00); D1, D2 – 1N914.

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Inexpensive HF-VHF Frequency Standard

There have been many frequency standard articles published in recent years using advanced technology integrated circuits[1,2]. However, there is a need for a foolproof circuit that is both inexpensive and easy to build in a modest workshop. While looking for a frequency standard for HF operations I noticed that most authors neglect the need for 30 kHz and 300 kHz markers in VHF FM operations, where 30 kHz is the standard channel spacing. Also, most 2m FM frequency standards neglect the needed 100 kHz and 10 kHz markers as used by the HF man.[2] This is why my interest developed for a simple design frequency standard which could develop both 30 kHz and 10 kHz markers as well as a host of other frequencies.

This standard uses readily available TTL integrated circuits which are available from many sources as advertised in the back of *73 Magazine*. The integrated circuits should not cost more than $4.50 total. The crystal I used was one from my junk box, but an International EX Crystal should work as well, and costs $4.95.

The block diagram of the frequency standard is shown in Fig. 1. Note that a five volt regulator was used to furnish the 5 volts needed by the TTL circuits. By using a regulator, an automobile 12 volt battery can be used to power the frequency standard when tuning up the mobile rig in the car. Also, a lantern battery may be used to power the unit for portable use as on field day. The 9 MHz oscillator is composed of a hex inverter operating in the linear mode. The 9 MHz output from the oscillator is divided by three to generate the 3 MHz signal used by the rest of the circuit. Two divide-by-ten circuits are then used to generate the 300 kHz and 30 kHz marker outputs. When 100 kHz outputs are required, another divide-by-three circuit is inserted between the 3 MHz signal and the divide-by-tens. Since there are two different outputs on each BNC connector, a small LED is used to signal when the second divide-by-three is in the circuit. The LED monitors the output of the divide-by-three, and when it is outputting, the LED is illuminated corresponding to 1 MHz, 100 kHz or 10 kHz selections. When the LED is not illuminated, then the outputs are 3 MHz, 300 kHz or 30 kHz.

The circuit diagram of the frequency standard is shown in Fig. 2. A 7404 TTL hex inverter is used as the crystal oscillator. A small 2-8 pF trimmer capacitor is used to permit zeroing the crystal with WWV. A 7476 TTL dual J-K flip flop is connected in a standard divide-by-three configuration. This same circuit is used later as the divide-by-three in order to produce the 100 kHz markers. A toggle switch selects either the second divide-by-three or bypasses it depending whether 100 kHz markers are needed. Two 7490 TTL decade dividers are then used to furnish the lower frequency markers.

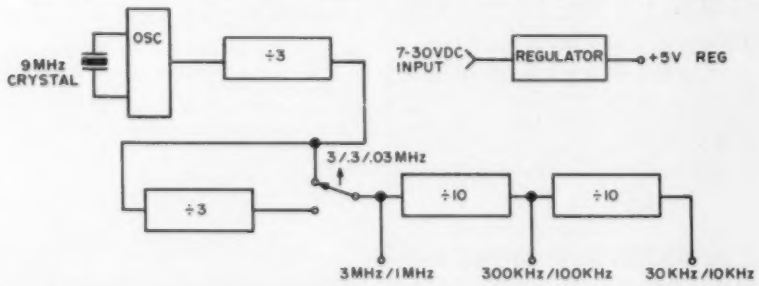

Fig. 1. Block diagram of the frequency standard. Selection of the 1 MHz/.1 MHz/.01 MHz is made by the toggle switch.

The TTL circuit layout is not critical. The standard, however, should be built close together to keep down stray capacitances. To help those who wish to duplicate the circuit, circuit boards are being made available.[3] Alternatively, the circuit may be built on a small vector board. Sockets may be used to help in the point-to-point wiring.

The board was mounted in a small aluminum box and BNC connectors were used for the outputs. The frequency standard is quite readable at 150 MHz and probably higher. Because of the square wave output, the harmonic content is very high. To calibrate the oscillator, the 100 kHz mode is chosen. The 100 kHz is then compared with WWV at 5, 10 or 15 MHz. The small trimmer capacitor is then adjusted until a zero beat is noted. Using this method, the harmonics at 146 MHz should be no more than a few Hz off. ■

References

[1] K. W. Robbins, "All Band Frequency Marker," *73*, June 1975, p. 88-90.

[2] "Frequency Standards," *FM and Repeaters*, ARRL 1972, p. 166-168.

[3] Printed circuit boards are available from I/O Engineering, 9503 Gambel's Quail Tr., Austin TX 78758. Undrilled, 2x4 inch is $3.75; drilled is $4.75 postpaid.

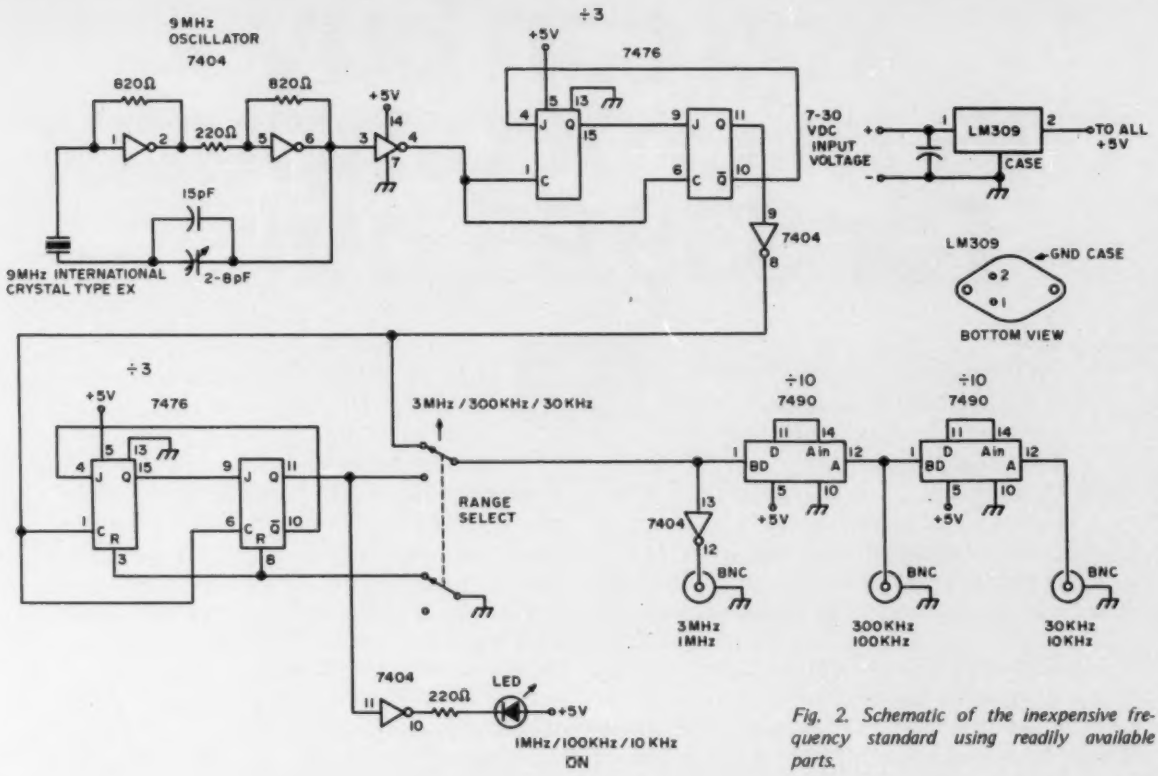

Fig. 2. Schematic of the inexpensive frequency standard using readily available parts.

Please put my name and the names of the organizations I represent on the list of available and eager ham radio teachers.

Steve Gold WB8OJF
Pres., Beachwood A. R. C.
Secy., South East A. R. C.
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Does anyone out there know where I can get a set of schematics for two pieces of equipment I have and can't get running? One is a Motorola Dispatcher, transistorized, model no. D.33BAT-1104A, xmtr. type CC3501, 6 volt.

The tough one came from the MARS program. It's a signal generator that looks like a very good model, but, as with all MARS equipment, it only half works. Though new, it looks like some one has taken the rippers to it and I don't want to get into it unless I have documentation. I'm willing to pay, if need be. It's a SG 47/USM-16, made by B. J. Electronics Div. of Borg Warner, Santa Anna CA. It has modulation, deviation, pulse and rf output 10 to 440 MHz. I have written to the above address but not received an answer. I understand that there are four books for this set, but I couldn't get them from the military. Any help out there?

Donald F. Kelso WA8YFO/4
6233 Pinewood Village
Circle West
Lakeland FL 33803

CORRECTION

"Build This $5 Timer," January, 1976, page 129: Five pin numbers from the NE555 were inadvertently omitted. Clockwise from the top, they should be 8, 3, 4, 2, 1, 7, 6. Our apologies.

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by Wayne Green W2NSD/1

EDITORIAL

COMPUTERS, SIMPLIFIED

The main part of the I/O section of *73* this month is taken up by a reprint of Nat Wadsworth's explanation of the basics of computers, originally published in the Scelbi-8B User's Manual. It is hoped that this article will dispel once and forever the idea that computers are something mysterious and incredibly difficult to understand.

Computers are complicated, but the basic parts of them are not difficult to get to know, and from there on it is a matter of a whole lot of the same thing over and over, so the complication is one of quantity.

For many ham applications of computers you can think of them as being an almost endless switchboard which can be operated by means of a keyboard rather than individual switches or the soldering of wires. Take a repeater, for instance. Right now repeater nuts have to wire in a time delay for the squelch tale, another for the three minute time out, an ID generator, another timer to play the ID at desired times, an autopatch decoder, and so forth. With a microcomputer, said nut can do all of that with a program. And if he wants to change the length of time for the squelch tale he can go on the air, access the repeater control computer and change it. Ditto the three minute timer . . . perhaps he'd like to shorten the drop out time to two minutes during drive time . . . no strain. The uP will turn on the cassette recorder during autopatches, etc. It is an almost infinitely flexible way of simulating a lot of electronic circuits. Now do you understand what all the fuss is about?

Amateurs have, for the most part, a decided advantage over most of the people who are already into computers. Most of these people are into the programming end of things and it just happens that programming is a lot easier to learn than electronics. We can learn programming quickly, but they will have a long hard row to hoe trying to catch up with us on the digital electronics end.

Well, perhaps you have no great interest in founding a multi-million dollar firm in microcomputers . . . no interest in grabbing a piece of the big computer pie in the sky which is coming. The estimated ham purchases of computers and accessories for this year is only about $50 million . . . let's see now, if we only get 2% of that market that is $1 million in sales. Hmmm. And once a few more people get hold of the Digital Equipment book on computer games the computer hobby market could explode. Fortunately DEC has managed to keep this book a tightly held secret . . . otherwise all hell might break loose. 101 utterly fascinating computer games and the programs to get them running all in one $7.50 book . . . fantastic.

With home use, hobby use, ham use, and business use, computers will be everywhere in a few years. Offices will use the same computer for bookkeeping, invoicing, writing letters (watch out IBM, your $850 Selectric typewriters are about to be made obsolete), inventory, addressing, payroll, indexing, and anything else that now uses paper, pencil, typewriter, etc. Your friendly local computer store will sell, program and service said ubiquitous computers. It is not often that we can see a multi-billion dollar market about to open up and decide whether we want to grab the shirttails or not.

CHU DIGITAL TIME

CHU, the Canadian Observatory station, has added a digital time function to its transmissions. This time tick uses the standard modem tones of 2025 and 2225 Hz and is sent during the 30-39th seconds of each minute. Who will be the first to come up with an article on using this time standard for a ham shack clock or computer application?

The time code is a modified ASCII at 300 baud. During the first 500 ms of each of the 30th to 39th seconds, CHU sends first 10 cycles of 1 kHz (bringing us up to 0.01 seconds . . . 10 ms), then 125 ms of 2225 Hz. This is followed by two bursts of the time code (182.5 ms each). If the two time bursts are not identical the pulses should be ignored.

The time bursts are made up of five 8-bit characters, each containing two decimal numbers (BCD), for a total of ten digits in the pulse. The first digit must be a six as this will prevent inversion of the code. The next three indicate the day of the year, then two for the hour of the day, two for the minute, and two for the second. 2025 Hz is level 1 and 2225 Hz is level 0.

Gearing up to use these digital time clicks is a fine project for you digital home brewers.

SOME PUBLICATIONS OF POSSIBLE INTEREST

by

Wayne Green W2NSD/1

and

Fred R. Goldstein WA1WDS

PCC — People's Computer Company, Box 310, Menlo Park CA 94025. This is a tabloid newspaper bi-monthly . . . $5 for six issues, $9 for two years . . . ran 32 pages in the latest issue. PCC is a mixture of chitchat, news of computers in the schools, game programs, news of products and services . . . emphasis is school computer use. Delightful. PCC has just announced a couple of new publications, TINY BASIC at three issues for $3, a newsletter on Tiny Basic, a new program language for tiny kids so they can write games, do math recreations and operate relays and other real time stuff. The other new publication is a series of booklets on Computers in the Classroom. Book 1, 60 pages Xeroxed, is $3.

Computer Hobbyist, Box 295, Cary NC 27511. $6 a year. This is an advanced type of newsletter and a major source for info from Hal Chamberlin, one of the leading computer hobbyist circuit designers. This is a little heavy for rank beginners . . . a recent issue had a program for generating random numbers and a cassette recorder interface circuit. Editor Stallings is doing a fine job.

Computer Notes, MITS, 6328 Linn Ave NE, Albuquerque NM 87108. While this newsletter is designed primarily for Altair owners, and much of it is far beyond the beginner to comprehend, it is a very well done and interesting publication. Costs $30 per year.

Creative Computing, Box 789, Morristown NJ 07960 . . . $8/yr. Bi-monthly. Heavy on games, complete with programs for them . . . heavy on school use of computers.

Micro-8 Newsletter, Cabrillo Computer Center, 4350 Constellation Road, Lompoc CA 93436. $6/6 issues. Aimed at the hobbyist, particularly the hardware enthusiast and the 8008 user. Tiny type and an enormous amount of info in each issue . . . sources of info, parts, equipment, names and addresses of other hobbyists. Circuits of interest. First rate source.

Microcomputer Dictionary and Guide. Matrix, Champaign IL 61820; $15.95 postpaid. Also available from Radio Bookshop, Peterborough NH 03458.

It's a whopper . . . well over 700 pages . . . and the price is right at $15.95. The term "dictionary" is not quite accurate . . . this is more like what you might expect in an encyclopedia. The definitions of computer terms are not brief; they are almost enough for you to learn about computers just from reading the book.

In a field where there is a completely new lexicon, where it is almost impossible to read articles in computer magazines or newsletters without an interpreter, where you can't even understand the computer folk when you try and talk with them, a dictionary such as this is invaluable.

It is an unfortunate fact that virtually everyone who is deeply involved with computers and has learned the new language also seems to have forgotten English. Computer folk are unable, to a man (it would seem), to write in English or even to talk it. They no longer talk with people, they interface. Without a lot

Continued on page 94

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EPOXY GLASS	04P44 092	4.69	6.50	2.07	1.85
	09P44 092	4.69	6.50	2.56	2.31
	169P44 092	4.50	17.00	5.94	4.53
	169P84 092	8.50	17.00	9.23	8.26
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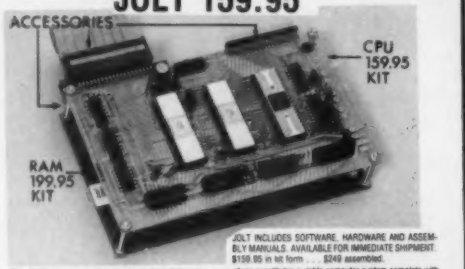

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JE SERIES KITS

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The JE801 is a three and one half digit, auto polarity digital voltmeter, in a kit form. It features several options not available in any commercial digital voltmeter. Its low cost is perhaps the most important feature, which is achieved by offering it in a kit form. A kit allows the unit to be used by small OEM's where cost effectiveness is an important factor, and by the hobbyist who has to be concerned with cost. The unit also features on card regulators, allowing it to be operated off a single plus and minus fifteen volt, unregulated power supply. The unit has a small size of three inches width, three and three quarters of an inch length, and one and a quarter inch height.

$39.95 Per Kit printed circuit board

JE803 PROBE

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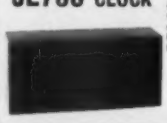
printed circuit board

JE700 CLOCK



The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2¼" x 1". It utilizes a MAN72 high brightness readout, and the MM5314 clock chip. **$16.95**

12 or 24 Hour

115 VAC— $19.95 per kit $29.95 assembled

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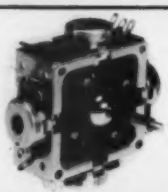

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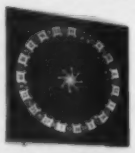

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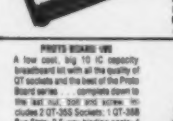

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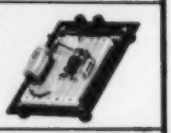

Bring IC leads from pc board for fast signal tracing and troubleshooting. Inject signals. Wire unused circuits into boards. Scope probes and test leads lock onto Dynagrip insert (see circle) for hands-off testing. Plastic construction eliminates springs, 4 points. Non-corrosive nickel-silver contacts for simultaneous low resistance connections.
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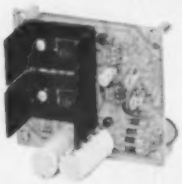

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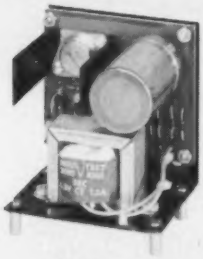

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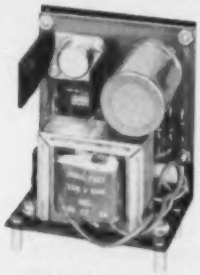

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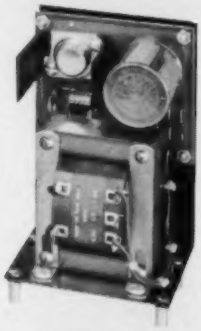

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by
Nat Wadsworth
SCELBI Computer Consulting Inc.
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Computers Are Ridiculously Simple!

Did you just get hooked? Has the first reaction of bewilderment and perplexity set in as you begin to explore the ins and outs of computing? Nat Wadsworth of SCELBI Computer Consulting – makers of an Intel 8008 based packaged microcomputer system – provides us with this article on fundamentals of computer operation. The article is written with the Intel 8008 in mind as an example of a typical computer, but the principles involved apply to nearly any microcomputer you can find on the market. The material of this article is taken from the first chapter of author Wadsworth's SCELBI-8H/B User's Manual, *one of the best documentation support packages among the various kit manufacturers.*

There have been numerous examples put forth over the years to illustrate the basic scheme behind the operation of computers. The scheme is deceptively simple and incredibly powerful. The power comes from the speed with which the machines can perform the simple operations. The fundamental concept of the computer is that it is a machine that is capable of doing two fundamental operations at very high speed: First it is able to obtain a piece of information from a storage area and perform a function as directed by the information it obtains; and secondly, based on its current status, it is able to ascertain where to obtain the next piece of information that will give it further "directions." This fundamental concept is the key to the operation of all digital computers and while it is a simple concept, it can be built upon to arrive at all the complex operations computers of today can perform. How this is done is what this article is about.

One of the best analogies for describing a computer's basic operations is to consider a bank of boxes, similar to a bank of Post Office mail boxes. A piece of paper containing "directions" can be placed in each box. A person is directed to go to the bank of boxes, and after starting at a given place, to open each box, withdraw the piece of paper and follow the directions there-on. The boxes are labeled in an orderly fashion, and the person is also told that unless a piece of paper in a box directs otherwise, when the person is finished performing the task directed, they are to replace the paper in the box and proceed to open the next box. Note, however, that a piece of paper may give directions to alter the sequence in which the person is to open boxes.

Fig. 1 shows a picture of a set of such boxes. Each box is labeled for identification.

To present a view of a computer's operation, assume a person has been told to start at box A1 and to follow the directions contained on the pieces of paper in the boxes until a piece of paper containing the direction "stop" is found in one of the boxes. In this example the person finds the following "instructions":

In box A1 is the message: *"Take the mathematical value of 1 and write it down on a scratch pad."*

Since the "instruction" in box A1 only pertained to some function that the person was to perform, and did not direct the person to go to some specific box, then the person will simply go on to the next box in the row.

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Box A2 contains the information:

"Add the number 2 to any value already present on your scratch pad."

The person will at this point perform an addition and have a total "accumulated" value on the pad of scratch paper. The accumulated value would be 3. Since there are no other directions in box A2, the operator would continue on to open box A3 which has the following message:

"Place any accumulated mathematical value you have on your scratch pad into box H8."

Thus the person would tear the current sheet off the "scratch pad" and place it – containing the value "3" – into box H8. Note, though, that while the person was directed to place the accumulated value on the scratch pad into box H8, the person was not directed to alter the sequence in which to obtain new "instructions" so the person would proceed to open box A4 which contains the directive:

"Take the mathematical value of 6 and place it on your scratch pad."

Going on to box A5 the person finds:

"Add 3 to the present value on your scratch pad."

This is obviously just a "data word." The operator adds the value 6 from the previous box to the number 3, noting the calculation on the scratch pad and proceeds to open box A6:

"Place any accumulated value you have on your scratch pad into box H7."

The person thus would put the value "9" on a piece of paper (from the scratch pad) into the designated box and proceed to open box A7:

"Get the value presently stored in box H8 and save the value on your scratch pad."

This is a simple operation and the person proceeds to open up box A8:

"Fetch the value in box H7. Subtract the value of your scratch pad from the value found in box H7. Leave the result on your scratch pad."

When the operator has performed this operation, the operator will have finished the "A" row and will then continue obtaining "instructions" by going to the "B" row and opening box B1 where more directions are found:

"If the present value on your scratch pad is not zero go to box B3."

At this time if the person checks the scratch pad it will be found that the value on the scratch pad is indeed non-zero as the last calculation performed on the scratch pad was to subtract the value in box H8 from the value in box H7. In this example that would be:

$$9 - 3 = 6$$

Therefore the directions in box B1 for this particular case will tell the operator to "jump over" box B2 and go to box B3. For the sake of completeness, however, box B2 does contain an instruction, for had the value on the scratch pad been zero the operator would not have "jumped over" box B2 and would have found the following message inside box B2:

"The values in box H7 and H8 are of equal value. STOP!"

However, for the values used in this example, the person would have "jumped" to box B3 where the following directive would be found:

"If the present value on your scratch pad is a "negative number" jump to box B5."

Since this is not currently the case the person will not "JUMP" to box B5, but will simply continue to open box B4 which contains:

"The value in box H7 is larger than the value in box H8. STOP!"

At this point the person has completed the "instruction sequence" for this example. It should be noted, however, that box B5 did contain the message:

"The value in box H7 is smaller than the value in box H8. STOP!"

This little example of a person opening up boxes and following the directions

The basic scheme behind the operation of computers is deceptively simple and incredibly powerful.

One of the best analogies for describing a computer's basic operations is to consider a bank of boxes, similar to a bank of Post Office mail boxes . . .

A1	A2	A3	A4	A5	A6	A7	A8
B1	B2	B3	B4	B5	B6	B7	B8
C1	C2	C3	C4	C5	C6	C7	C8
D1	D2	D3	D4	D5	D6	D7	D8
E1	E2	E3	E4	E5	E6	E7	E8
F1	F2	F3	F4	F5	F6	F7	F8
G1	G2	G3	G4	G5	G6	G7	G8
H1	H2	H3	H4	H5	H6	H7	H8

Fig. 1. A set of Post Office pigeon holes containing messages.

Fig. 2(a). The computer structure compared to the Post Office pigeon holes.

POST OFFICE BOXES

A1	A2	A3	A4	A5	A6	A7	A8
B1	B2	B3	B4	B5	B6	B7	B8
C1	C2	C3	C4	C5	C6	C7	C8
D1	D2	D3	D4	D5	D6	D7	D8
E1	E2	E3	E4	E5	E6	E7	E8
F1	F2	F3	F4	F5	F6	F7	F8
G1	G2	G3	G4	G5	G6	G7	G8
H1	H2	H3	H4	H5	H6	H7	H8

= MEMORY

PERSON = CENTRAL PROCESSING UNIT

PAD & PENCIL = ACCUMULATOR

contained in each one is very similar to the concept used by a computer. Note that each "instruction" is very short and specific. Also note that the combination of all the instructions in the example will result in the person being directed to solve the problem:

Is 1 + X greater than, less than, or equal to: 6 + Y?

For the reader can note, if the "data words" contained in boxes A2 and A5 for the example were changed, the sequence of "instructions" would still result in the person being told to "STOP" at the box that contained the correct answer. The reader can verify this by simply assuming that different numbers than those used in the example are in boxes A2 and A5 and going through the instruction sequence until told to "STOP."

The example illustrates how a carefully planned set of directions, arranged such that they are performed in a precise sequence, can be used to solve a problem even though the "variables" (data) in the problem may vary. Such a set of "instructions" is often termed an "algorithm" by those in the computer field. The example solved a mathematical problem using the "algorithm," but the reader will find that "algorithms" can be devised to solve many problems on a computer that are not strictly mathematical!

Any person learning a new skill must of necessity learn the vocabulary of the field in order to proceed to any great extent. You might think that it would be easier if everything was written in plain everyday words, but the truth of the matter is that specialized vocabularies do serve several useful functions. For one thing, they can greatly shorten the time that it takes to communicate ideas or concepts. In today's fast-moving world, that is of significance in itself. In addition, the limitations of the English language often result in a given word having a special meaning when it is used in the context of a particular subject. One must know the new meaning when it is used in such a manner. Fortunately, much of the computer vocabulary is very logically named. This is probably due partly to the fact that computers are of necessity extremely dependent on logic, and hence many persons who helped create the field – and by that fact were rather logically oriented themselves – seem to have had the logical sense to have named many of the parts and systems of computers and computer programs, in a logical manner.

In the text which follows, two diagrams, Figs. 2(a) and 2(b), are used to demonstrate the analogy between the person taking "instructions" from a group of mail boxes and the basic operation of a real minicomputer.

Fig. 2(a) shows the Post Office boxes, a figure representation of a person who is able to "fetch" and return the "instructions" or "data" from and to the boxes, and a "scratch pad" on which the person can make temporary calculations when directed to do so.

In Fig. 2(b) are three interconnected boxes which form a "block diagram" of a computer. The uppermost portion of the "block diagram" is labeled the "memory." The middle portion is labeled the "central processor unit" or "CPU" for short. The lower part of the diagram depicts an "accumulator."

The correlation between the two pictures is extremely simple. The "Post Office boxes" correspond to the "memory" portion of a real computer. The "memory" is a storage place, a location where instructions and data can be stored for long lengths of time. The "memory" can be "accessed." "Instructions" and/or "data" can be taken out of memory, operated on, and replaced. New "data" can be put into the "memory." A "memory" that can be "read from" as well as "written into" is called a "read and write memory." A "read and write memory" is often referred to as a "RAM" as an abbreviation. Many times it is feasible to have a "memory" that is only "read from." A memory that is never "written into," but is only used to "read from," is termed a "read only memory" and is abbreviated as a "ROM." For the present discussion the term "memory" will refer to a "read and write memory" ("RAM").

The figure of a person in Fig. 2(a) corresponds to the central processor unit in Fig. 2(b). The cental processor

unit in a computer is the section that "controls" the overall operation of the machine. The "CPU" can receive (fetch) "instructions" or "data" from the memory. It is able to "interpret" the "instructions" it fetches from the memory. It is also able to perform various types of mathematical operations. It can also "return" information to the memory – for instance make deposits of "data" into the memory. The "CPU" also contains control sections that enable it to sequentially "access" the "next" location in memory when it has finished performing an operation, or, if it is directed to do so, to "access" the memory at a specified location, or to "jump" to a new area in memory from which to continue fetching "instructions."

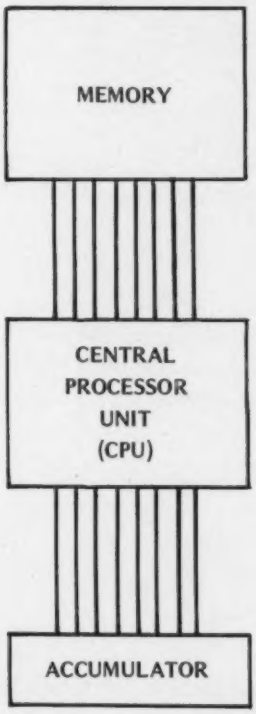
The pad of paper and pencil in Fig. 2(a) corresponds to the block titled "accumulator" in Fig. 2(b). The "accumulator" is a temporary "register" or "manipulating area" which is used by the CPU when it is performing operations such as adding two numbers. One number or piece of information can be temporarily held in it while the central processor unit goes on to obtain additional instructions or data from memory. It is an electronic "scratch pad" for the CPU.

The three fundamental units – the memory, central processor unit, and the accumulator – are at the heart of every digital computer system. Of course, there are other parts which will be added in and explained later, but these fundamental portions can be used to explain the basic operation of a digital computer which is the purpose of this article.

The reader should learn the names of the basic parts of the computer as they are presented. Note how easy it is to remember the portions that have been shown. The "remembering" element is a "memory." The portion that does the "work" or processing is simply termed the "central processor unit," and the part that is used to accumulate information temporarily is aptly called the "accumulator!"

The reader should now have a conceptual view of the concept behind a computer's operation and an understanding of the machine's most basic organization. It is simply a machine that can fetch information from a memory, interpret the information as an instruction or data, perform a very small operation, and continue on to determine the next operation that is to be performed. Each operation it is capable of doing is very tiny by itself, but when the many operations of a typical "program" are performed in sequence, the solutions to very complex problems can be obtained. It is important to remember that the computer can perform each little operation in just a few millionths of a second! Thus a program that might seem very large to a person – say one with many thousands of individual instructions – would only take a digital computer a few thousandths of a second to perform. The speed with which the computer can execute individual instructions is what gives the computer its seemingly fantastic capability.

Fig. 2(b). Block diagram of a computer's fundamental components.



It is now time to start delving into the actual physical manner in which a computer operates. How can a machine be constructed so that it is able to perform the processes of the central processor unit? While it will require a number of pages of text to explain the procedure, it is not nearly as difficult to understand as many people might suspect. The complexity of a computer when first viewed by a person is caused by the fact that it appears to consist of many hundreds of parts. It becomes much simpler when one understands that the hundreds of parts are really made up from a few dozen similar parts and they are carefully organized into just a few major operating portions. The reader is already familiar with the most fundamental portions.

As fantastic as it may sound at first, a digital computer can be thought of as really nothing more than a highly organized collection of "on or off" switches! Yes, computers are constructed from electronic devices that can only assume one of two possible states! The electronic switches can be constructed in a variety of ways. For instance, the switch can be made so that the voltage at a given point is either high or low, or current through a device is either flowing or not flowing, or flowing in one direction, and then the other direction. But, regardless of how the electronic switch is constructed, its status can always be represented as being either "on" or "off." This "on" or "off" status can be mathematically symbolized most suitably by a mathematical system based on "binary" notation.

Some people tend to think that computers are very difficult to understand because they have heard of "strange" types of mathematics that are often

As fantastic as it may sound at first, a digital computer can be thought of as really nothing more than a highly organized collection of "on or off" switches!

referred to in conjunction with computers. In actuality much of the mathematics that are dealt with in computer technology are much easier to understand and deal with than the decimal system that the average person is familiar with. In the decimal numbering system a person must learn 10 different symbols, and in order to manipulate those symbols, they must memorize a lot of information. For instance, look at how students are taught to multiply. The learning process actually involves the student having to memorize a rather large number of facts. Because of the way it is typically taught, most students never realize how much work they have to go through just to learn the multiplication tables! The teacher does not stand up and say, "OK, now you are going to memorize about 100 facts." Instead, over a period of a few weeks or so, the student is made to memorize the 100 or so facts — a few at a time. The student must learn the value of each digit multiplied by all the other digits in the decimal numbering system. The decimal numbering system is far more complicated for the beginner than learning the binary numbering system, and the binary numbering system is the one utilized by computers at their most basic functioning level. The reason the computer uses the binary system is because it is the simplest system around and hence the easiest one with which to construct a computing machine!

Readers know the word "binary" indicates "two." Computers are built up of electronic switches that can only have two possible states. The switches are binary devices. The status of the switches can be represented mathematically utilizing the "binary" numbering system. The binary numbering system only has two digits in it! They are zero (0) and one (1). A switch can thus be mathematically symbolized, for instance, by a zero when it is "off" and a one when it is "on." The opposite relationship could also be established, a one could be used to represent a switch being "off" and a zero used to represent a switch as "on." It would make no difference mathematically which convention was used as long as one was consistent. For the purposes of the present discussion, the reader can assume that the first convention (switch off = 0, switch on = 1) will be used.

It should be immediately apparent that working with a numbering system based on only two integers will be a lot easier than working with one having 10 integer symbols. In fact, most problems for people learning the binary system come about because they tend to forget how simple it is, and they tend to keep going towards a decimal solution out of habit when they are working with the binary system. For instance, when one starts to add binary numbers, as soon as the value "1" is exceeded, a "carry" to the next column must be made. The value of the addition of "1 + 1" in the binary system is: 10. It is not 2! There is no such integer as "2" in the binary numbering system. However, when a person who has worked with the decimal system for years first starts working with the binary system, old decimal habits tend to get in the way. The reader will have to beware!

To formally introduce the binary mathematical system one can start by stating that it uses two integers, zero (0) and one (1), and no others. A binary number has a value determined by the value of the integers that make up the number, and the position of the digits.

In the decimal numbering system, the reader is familiar with the location of a digit having a "weighted" value as follows: A three digit number has a value determined by the unit value of the digit in the right-most column plus the value of the digit to the left of it multiplied by 10, plus the value of the third digit multiplied by one hundred as illustrated in the following example:

THE DECIMAL NUMBER
345 IS EQUAL TO:

5 UNITS = 5
PLUS(+) 4 TIMES 10 = 40
PLUS (+) 3 TIMES 100 = 300

In other words, after the right-most column (which has the value of the digit), each column to the left is given a weighting factor which increases as a power of the total number of digits utilized by the numbering system. Note that in the above example the 4 representing 40 units is equal to 4 times the number of integer symbols in the decimal system (10) because it is located in the second column from the right. The number 3 representing 300 units is equal to 3 times the number of integer symbols in the decimal system squared because it is located in the third column from the right. This relationship of the weighted value of the digits based on their position can be described in mathematical shorthand as follows:

If the number of different integer symbols in the numbering system is U (for the decimal system U=10)

and the column whose weighted value is to be determined is column number M (starting with the right-most column and counting to the left)

and any digit is represented by the symbol X

then the weighted value of a digit in column M is expressed as:

X times U raised to the power (M-1) or $XU^{(M-1)}$

The reader can easily verify that the above formula applies to the decimal numbering system. However, the above formula is a general formula that can be used to determine the weighted positional value of any numbering system. It will be used to determine the weighted positional values of numbers in the binary numbering system.

In the binary numbering system there are just two different integer symbols (0

and 1). Thus U in the above formula is equal to 2. For illustrative purposes assume the following binary number is to be analyzed:

1 0 1

and it is desired to determine its value in terms of decimal numbers. (Remember its binary value is just 1 0 1). Using the above formula for the digit in the right-most column: M is equal to 1, thus (M-1) is equal to 0, and with X = 1:

Weighted Value = $X \cdot U^{(M-1)} = 1 \cdot 2^0 = 1$

(Remember that any number raised to the zero power is equal to 1.) Going on to the next digit it can be seen that the weighted value is simply 0! Finally, the digit in the third column from the right has the weighted value because of its position:

Weighted Value = $X \cdot U^{(M-1)} = 1 \cdot 2^{(3-1)} = 2^2 = 4$

Then, by adding up the sum of the weighted values (similar to that done for the decimal example earlier) one can see that the decimal equivalent of 1 0 1 binary is 5:

THE BINARY NUMBER 101

IS EQUAL TO:

1 UNITS = 1

+ 0 TIMES 2 = 0

+ 1 TIMES 4 = 4

and thus 1 0 1 in the binary numbering system is the same as 5 in the decimal numbering system.

There will be more to learn about the binary numbering system. However, the brief information given will be enough to continue on with the discussion that this section is primarily concerned with – the basic operation of a computer. Since the reader is now aware that a computer is composed of numerous electronic switches and knows that one can use a mathematical shorthand to represent the status of the switches (whether they are "on" or "off"), and is also aware of the fundamental concept behind a computer's operation, it is now possible to proceed to show how electronic switches can be arranged to build a functional computer. That is, how the electronic switches can be arranged and interconnected in a fashion that will allow a machine to "fetch" a piece of information from a "memory" section, decode the information so as to determine an "instruction," and also determine where to obtain the next instruction or additional "data."

To begin this part of the discussion it will be beneficial for the reader to picture a group of cells (similar to the Post Office boxes shown earlier) arranged in orderly rows as shown in Fig. 3. This time, instead of each cell holding a complete instruction, it can be understood that each cell only represents part of an instruction and that it takes a whole row of cells to make up an instruction. Furthermore, each cell may only contain the mathematical symbol for a one (1) or a zero (0) – or, in other words, its contents represent the status of an electronic switch!

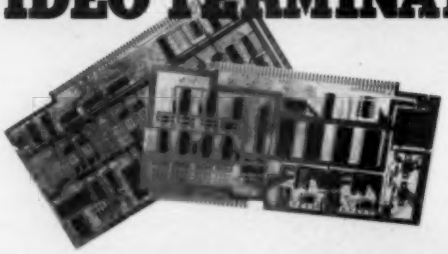
At this time a few more computer technology definitions will be illustrated. In Fig. 3, each box containing a binary 1 or 0 represents what is called a "bit" of information. While each cell may only contain one piece of information at a time, a cell can actually represent one of two possible states of information. This is because the cell can be in two possible states – it either contains a zero or a one. If one starts assigning positional values to the cells in a row, it can be seen that the total number of possible states in one row will increase rapidly. For instance, two cells in a row can represent up to four states of information. This is because two cells side-by-side, containing either a 0 or 1 in each cell can have one of the following four states at a particular moment in time: 1

The decimal numbering system is far more complicated for the beginner than learning the binary numbering system, and the binary numbering system is the one utilized by computers at their most basic functioning level.

WORD #1	1	0	1	0	1	0	1	0
WORD #2	0	1	0	1	0	1	0	1
WORD #3	1	1	0	0	1	1	0	0
WORD #4	0	0	1	1	0	0	1	1
WORD #5	1	1	1	1	0	0	0	0
WORD #6	0	0	0	0	1	1	1	1
WORD #7	1	1	1	1	1	1	1	1
WORD #8	0	0	0	0	0	0	0	0

Fig. 3. An array of electronic cells, 8 bits per cell.

ALTAIR 8800
VIDEO TERMINAL



Video Interface. Plugs into the Altair or IMSAI 8800 bus and connects to standard TV monitor (or modified receiver). 8-bit input connects to almost any keyboard. Characters are displayed as 16 lines of 64 or 32 characters each, in a 7x9 dot matrix. (64 character line requires a high resolution monitor or extensively modified receiver.) The character set includes 128 upper and lower case ASCII characters and 64 graphics characters for plotting a 48x128 (or 64) grid. Characters are stored in the onboard memory and may be accessed directly by the computer. The output is standard 525 line EIA RS170 video.

$160 Kit $230 Assem. and tested (Add $25 for 64 character option) delivery 30 days

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Analog Interface. This board is a complete interface for a CRT graphics display or an X-Y plotter, and provides 8 channels of software-controlled A/D conversion. There are 1 or 2 channels of analog output with 10-bits resolution (0-10v or ±5v out), 6-bits of latched digital output, and 8 analog comparators.

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Microcomputer System. A system based on our microcomputer and video boards. Includes motherboard, cabinet, power supply, and an operating system and monitor on PROM. (Avail. 1st Q. 1976)

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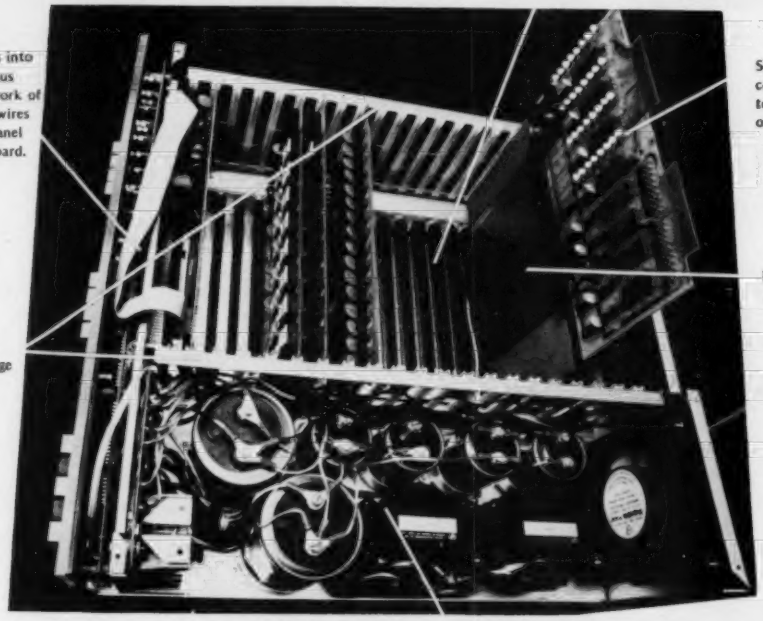
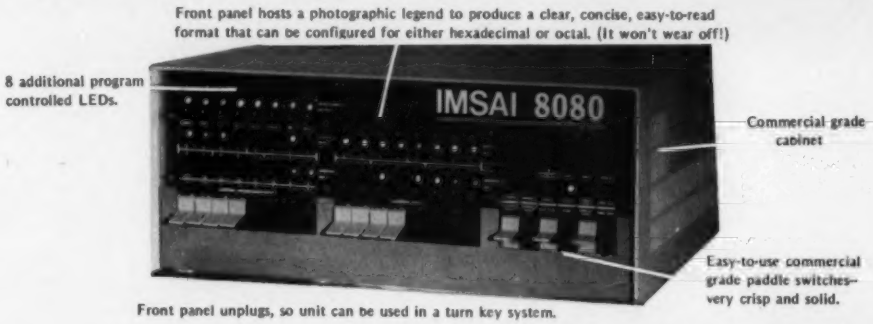
IMSAI

The IMSAI 8080 can be configured with optional Mother Board to provide a full 22 slots. (shown)


Front panel plugs into Mother Board, thus eliminating the work of soldering all the wires from the front panel to the Mother Board.
Special PIO Board configured with LEDs to monitor each bit of each of the 4 ports.
Extender Board available
Sturdy Card Cage
Heavy duty power supply (optional dual power supply shown.)

The IMSAI 8080 is designed using the full Intel family of large scale integration chips, thus providing high reliability and greater flexability.


Front panel hosts a photographic legend to produce a clear, concise, easy-to-read format that can be configured for either hexadecimal or octal. (It won't wear off!)
8 additional program controlled LEDs.
IMSAI 8080
Commercial grade cabinet
Easy-to-use commercial grade paddle switches– very crisp and solid.
Front panel unplugs, so unit can be used in a turn key system.

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The combination of the eight cells can be filled with zeros and ones in 256 different patterns.

0, 0 1, 1 1, or 0 0. Three cells in a row can represent up to eight states of information as the possible states of three cells side-by-side are: 0 0 0, 0 0 1, 0 1 0, 0 1 1, 1 0 0, 1 0 1, 1 1 0, 1 1 1. In fact, when each cell can represent a binary number, the total number of states of information that a row of "N" cells can represent is: 2 to the Nth power, 2^n. Thus, a row of eight binary cells can represent 2 to the eighth (256) states of information! That is, the combination of the eight cells can be filled with zeros and ones in 256 different patterns!

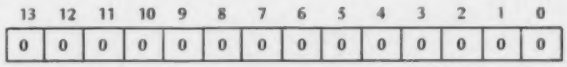
A group (row) of cells in a computer's memory is often referred to as a "word." A "word" in a computer's memory is a fixed size group of cells that are "accessed" or manipulated during one operational cycle of the central processing unit (CPU). The CPU will effectively handle all the cells in a "word" in memory simultaneously whenever it processes information in the memory. Digital computers can have varying "word lengths" depending on how they are engineered. Many microcomputers have a memory word size consisting of eight cells. The number of cells in a word, and the number of words in a computer's memory have a lot to do with the machine's overall capability. In the typical microcomputer system, the memory is available in modules – groups of words which can be plugged into a common set of wires in the system. With current LSI technology, a typical module of moderate price has 1024 bytes in an 8-bit computer system. With the 8008 oriented design serving as the basis for this article, one could potentially plug in 16 such modules for a total of 16,384 bytes or 131,072 bits. Thus, a large amount of information can be "stored" in the computer's memory at any one time.

The astute reader may have already figured out a very special reason for grouping cells into "words" in memory. It was pointed out earlier that a row of eight cells could represent up to 256 different patterns. Now, if each possible pattern could be "decoded" by electronic means so that a particular pattern could specify a precise "instruction" for the central processor unit, then a large group of "instructions" would be available for use by the machine. That is exactly the concept used in a digital computer. Patterns of ones and zeros organized into a computer "word" are stored in memory. The CPU is able to examine a word in memory and decode the pattern contained therein to determine the precise operation that it is to perform. Most microcomputers do not decode every one of the possible 256 patterns that can be held in a row of eight cells as an instruction. They have an "instruction set" of over 100 "instructions" which are represented by different patterns of ones and zeros in an eight cell memory "word." Each pattern that represents an "instruction" can be decoded by the CPU and will cause the CPU to perform a specific function. Details of all the functions a computer can perform are usually found in the manufacturer's documentation.

There is another ingredient necessary for making the machine "automatic" in operation. That is that the CPU must "know" where to obtain the next "instruction" in memory after it completes an operation. That function is greatly aided by having the memory cells grouped as "words." The reader should note that in Fig. 3 each group of cells representing a word was labeled as: "word #1," "word #2," etc. There is a special portion of the central processor unit that is used to control where the next word containing an instruction in memory is located. This special part is commonly referred to as the "program counter." One reason it was given the name "program counter" is because most of the time all it does is count! It counts memory words! Each word in memory is considered to have an "address." In Fig. 3 each word was given an "address" by simply designating each word with a number. Word #1 has an "address" of 1. Word #2 has an address of 2, etc. The "program counter" portion of the CPU keeps tabs on where the CPU should obtain the next instruction by maintaining an "address" of the word in memory that is to be processed! About 90% of the time all the program counter does is "increment" the value it has each time the CPU finishes doing an operation. Thus, if the computer were to start executing a simple program that began by its performing the instruction contained in "word #1" in memory – the very process of having the machine start the program at that location in memory would cause the program counter to assume a value of 1. As soon as the CPU had performed the function the "program counter" would increment its value to 2. The CPU would then look at the program counter and see that its next instruction was located in word #2 in memory. When the instruction in word #2 has been processed the "program counter" would increment its value to 3. This process might continue uninterrupted until the CPU found an instruction that told it to "STOP."

A sharp reader might be starting to ask, "Why have a program counter if each instruction follows the next?" The answer is simply that the availability of a "program counter" gives the freedom of not having to always take the instruction at the next "address" in memory. This is because the contents of the "program counter" can be changed when the CPU detects an "instruction" that directs it to do so! This enables the computer to be able to "jump" around to different sections in memory, and as will become apparent later, greatly increases the capability of the machine.

Fig. 4. The program counter of an 8008 based machine.



The "program counter" is actually just a group of cells in the CPU that may contain either a binary zero or one. The binary value in the row of cells that constitute the program counter determines the "address" of a word in memory. Since the number of words in memory can be very large, and since the program counter must be capable of holding the address of any possible location in memory, the number of cells in a row in the program counter is larger than the number of cells in a word in memory. In an 8008 oriented computer design, for example, the number of cells in the program counter is 14. Since 2 to the 14th power is 16,384, the program counter can present up to 16,384 different patterns. Each pattern can be used to represent the "address" of a word in memory. Fig. 4 illustrates what the contents of the program counter would look like when it contained the address for a specific word in memory. The address the example displays is "address 0" which can be considered the first word in memory. The reader should note that an address of zero can actually represent a word in memory!

Earlier it was stated that some "instructions" can actually change the value of the program counter and thus allow a program to "jump" to different sections in memory. However, the reader now knows that a word in memory only contains eight cells, and yet the program counter of an 8008 based computer contains 14 cells. In order to change the entire contents of the program counter (by bringing in words from memory), it is necessary to use more than one memory word! This can be done if the program counter is considered to actually be two groups of cells connected together. One group contains eight cells, and the other six. In order to change the contents of the entire program counter, one whole eight cell word could be read from a memory location and placed in the right-hand group of eight cells of the program counter. Then another eight cell word could be read from memory. Since only six more cells are needed to finish filling the program counter, the information in two of the eight cells from the second word brought in from memory could be "discarded." If the information in the two left most cells of the word in memory were thrown away then the remaining six cells would contain information that could be placed in the six unfilled locations in the program counter. Most of the common 8-bit microcomputers use a similar scheme of breaking an address into two pieces when the program counter is loaded in a jump instruction.

In order to make it easier for a person working with the machine to remember "addresses" of words in memory, a concept referred to by computer technologists as "paging" is utilized. "Paging" is the arbitrary assignment of "blocks" of memory words into sections that are referred to figuratively as "pages." The reader should realize that the actual physical memory unit consists of all the words in memory – with each word assigned a numerical address that the machine utilizes. As far as the machine is concerned, the words in memory are assigned consecutive addresses from word #0 on up to the highest word # contained in the memory. However, people using computers have found it easier to work with addresses by arbitrarily grouping "blocks" of words into pages. For example in the Intel 8008 "pages" are considered to be "blocks" of 256 memory words. The first memory word address in an 8008 system is at address zero (0). Programmers could refer to this word as word #0 on page #0. The 256th word in memory as far as the computer is concerned has an address of 255. (Note: Since the address of 0 is actually assigned for the first physical word in memory, all succeeding words have an address that is one less than the physical quantity!) A programmer could refer to this word as word #255 on page #0. The 257th word in memory has an absolute address of 256 ("n"th word minus one since location 0 contains a memory word) as far as the machine is concerned, but a programmer could refer to that word location as being on page #1 at location 0! Similarly, the 513th word in memory, when the paging concept is used, becomes word #0 on page #2 for a programmer – but it is just 512 as far as the machine is concerned. Paging at multiples of 256 is a convenient tool when dealing with any 8-bit microcomputer.

The reader might have noted a nice coincidence in regards to the assignment of "paging" in 8-bit computers. Each "page" refers to a

There is a special portion of the central processor unit (CPU) that is used to control where the next word containing an instruction in memory is located – the "program counter." Most of the time all it does is count!

"block" of memory words that contains 256 locations (0 to 255). The reader will recall that that is exactly the number of different patterns that can be specified by a group of eight binary cells, and there are eight binary cells in a memory "word." The relationship is more than coincidental! Note that now one has devised a convenient way for a person to be able to think of memory addresses and at the same time be able to specify a new address to the program counter that will still result in it containing an "absolute" address that the machine can use. For instance, if it was desired to change the contents of the 14 cell program counter from an absolute address of word #0, say to word #511, the following procedure could be used: The programmer would first specify an instruction that the CPU would decode as meaning "change the value in the program counter." (Such an instruction might be a "jump" instruction in the instruction set.) Following that instruction would be a word that held the desired value of the "low order address" or word # within a "page." Since a memory word only has eight cells, since eight cells can only represent 256 different patterns, and since one of the patterns is equivalent to a value of zero, then the largest number the eight cells can represent is 255. However, this is the largest word # that is contained on a page. This value can be placed in the right-most eight cells of the program counter. Now it is necessary to complete the address by getting the contents of another word from memory. Thus, immediately following the word that contained the "low address" would be another word that contained the "page #" of the address that the program counter was to contain. In this case the page number would be 1. When this value is placed in the left six cells of the program counter the program counter would contain the pattern in Fig. 5.

Fig. 5. The program counter with address 511 represented in binary notation.

13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	0	0	0	1	1	1	1	1	1	1	1	1

If desired, the reader can verify by using the formula presented previously for determining the decimal value of a binary number, that the pattern presented in Fig. 5 corresponds to 511, and thus, by using the "page #" and "word # on the page," each of which will fit in an eight cell memory word, a method has been demonstrated that will result in the program counter being set to an absolute address for a word in memory. Fig. 6 provides some examples as a summary.

By now the reader should have a pretty good understanding of the concepts regarding the organization of memory into electrical cells which can be in one of two possible states, the grouping of these cells into "words" which can hold patterns which the CPU can recognize as specifying particular operations, and the operation of a "program counter" which is able to hold the "address" of a word in memory from which the CPU is to obtain an instruction.

It is now time to discuss the operation of the "scratch pad" area for a computer – the accumulator (and some

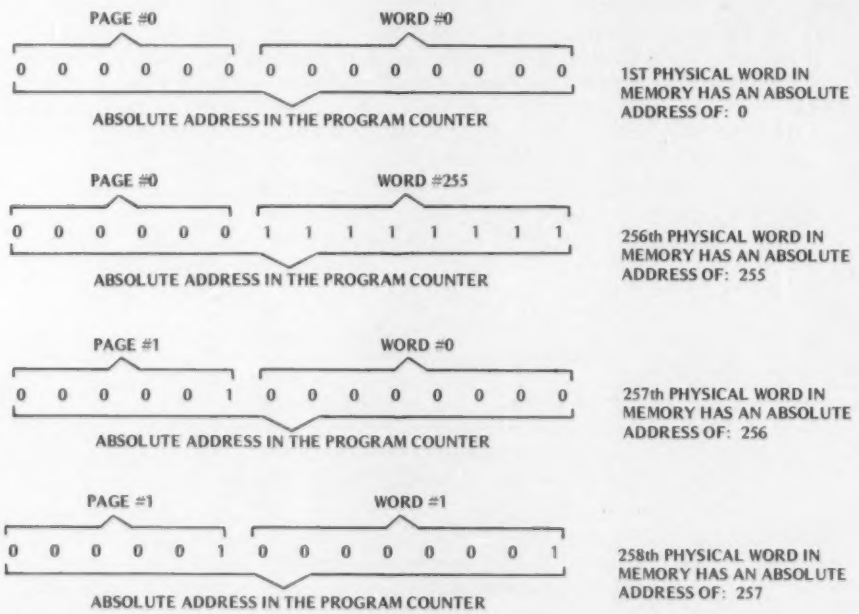

PAGE #0
WORD #0
0 0 0 0 0 0 0 0 0 0 0 0 0 0
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
1ST PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 0
PAGE #0
WORD #255
0 0 0 0 0 0 1 1 1 1 1 1 1 1
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
256th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 255
PAGE #1
WORD #0
0 0 0 0 0 1 0 0 0 0 0 0 0 0
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
257th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 256
PAGE #1
WORD #1
0 0 0 0 0 1 0 0 0 0 0 0 0 1
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
258th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 257

Fig. 6. Examples of addresses in an 8008 based system.

additional "manipulating registers" in the typical 8008 based computer).

As was pointed out earlier, there is a section of a computer that is used to perform calculations in and which can hold information while the CPU is in the process of "fetching" another instruction from the memory. The portion was termed an "accumulator" because it could "accumulate" information obtained from the CPU performing a series of instructions until such time as the CPU was directed to transfer the information elsewhere (or discard it). The accumulator is also considered to be the primary "mathematical" center for computer operations for it is the place where additions, subtractions, and various other mathematically oriented operations (such as Boolean algebra) are generally performed under program control.

The concept of an "accumulator" is not difficult to understand and its physical structure can be readily explained. The actual control of an accumulator by the CPU can be quite complex, but these complex electronic manipulations do not have to be understood by the computer user. It is only necessary to know the "end results" of the various operations that can be performed within an accumulator.

The accumulator in an Intel 8008 based machine can be considered as a group of eight "memory cells" similar to a "word" in memory except that the information in the cells can be manipulated in many ways that are not directly possible in a word in memory.

Fig. 7 shows a collection of eight binary cells containing ones and zeros to represent an accumulator. The cells are numbered from left to right starting with "B7" down to "B0." The designations refer to "bit positions" within the accumulator. Note that the right-most cell is designated B0 and the eighth cell (left-most cell) is designated B7. The reader should become thoroughly familiar with the concept of assigning the reference of "zero" to the right-most bit position in a row of cells (similar to the concept of assigning a reference of zero to the first address of a word on a page in memory) as the convention is frequently used by computer technologists. The convention can be confusing for the beginner who fails to remember that the physical quantity is one more than the reference designation. The convention of labeling the first physical position as zero makes much more sense once the reader learns to think in terms of the binary numbering system and thoroughly realizes that the "zero" referred to so frequently in computer work when discussing actual operations actually represents a physical state (the status of an electronic switch) and does not necessarily imply the mathematical notion of "nothing." The concept of assigning a bit designation to the positions of the cells within the accumulator will allow the reader to follow explanations of various accumulator operations.

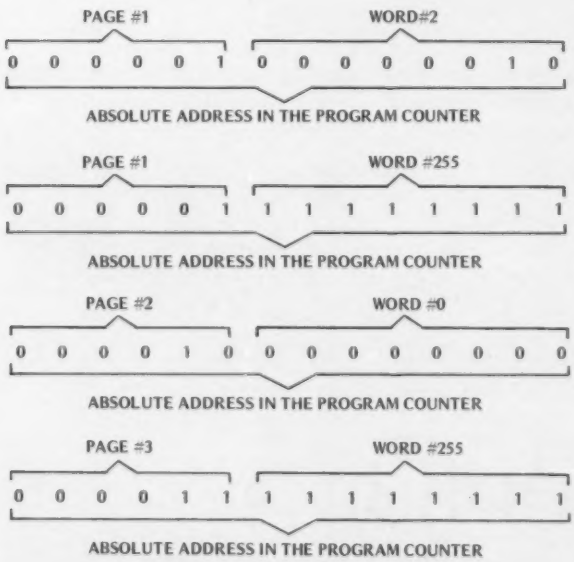
Fig. 7. The accumulator, pictured with binary 10101010 (decimal value 160) in its 8 bits.

B7	B6	B5	B4	B3	B2	B1	B0
1	0	1	0	1	0	1	0

The accumulator simply holds a number–it adds and subtracts–and "rotates" its contents.

One of the most fundamental and most often used operations of an accumulator is for it to simply hold a number while the CPU obtains a second operator. In an 8008 type of machine the accumulator can be "loaded" with a value obtained from a location in memory or one of the "partial accumulators." It can then hold this value until it is time to perform some other operation with the accumulator. (It will become apparent later that the accumulator of an 8008 can also receive information from external devices.)

Perhaps the second most often used operation of an accumulator is to have it perform mathematical operations such as addition or subtraction with the value it contains at the time the function is performed and the contents of a memory location or one of the "partial accumulators." Thus if the accumulator contained


PAGE #1
WORD#2
0 0 0 0 0 1 0 0 0 0 0 0 1 0
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
PAGE #1
WORD #255
0 0 0 0 0 1 1 1 1 1 1 1 1 1
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
PAGE #2
WORD #0
0 0 0 0 1 0 0 0 0 0 0 0 0 0
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER
PAGE #3
WORD #255
0 0 0 0 1 1 1 1 1 1 1 1 1 1
ABSOLUTE ADDRESS IN THE PROGRAM COUNTER

259th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 258

512th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 511

513th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 512

1024th PHYSICAL WORD IN MEMORY HAS AN ABSOLUTE ADDRESS OF: 1023

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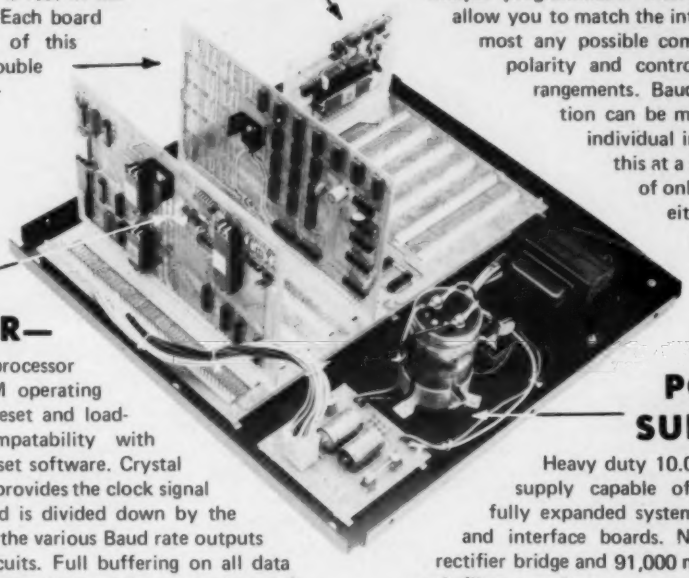

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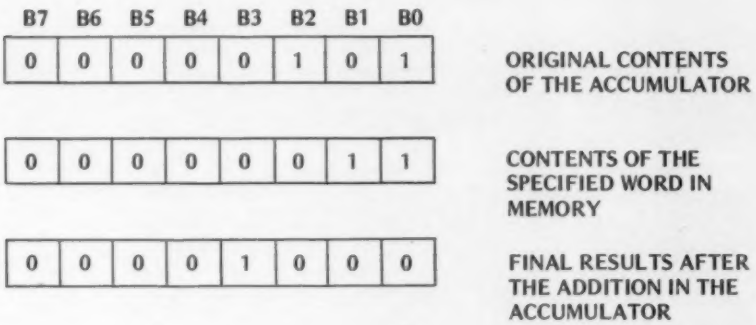
Fig. 8. Adding the content of a memory word to the accumulator.


B7 B6 B5 B4 B3 B2 B1 B0
0 0 0 0 0 1 0 1
ORIGINAL CONTENTS OF THE ACCUMULATOR
0 0 0 0 0 0 1 1
CONTENTS OF THE SPECIFIED WORD IN MEMORY
0 0 0 0 1 0 0 0
FINAL RESULTS AFTER THE ADDITION IN THE ACCUMULATOR

the binary equivalent of the decimal number 5, and an instruction to add the contents of a specific memory location which contained the binary equivalent of the decimal number 3 was encountered, the accumulator would end up with the value of 8 in binary form as shown in Fig. 8.

Perhaps the next most frequently used group of operations for the accumulator is for it to perform "Boolean" mathematical operations between itself and/or other "partial accumulators" or words in memory. These operations in the typical microcomputer include the logical "and," "or," and "exclusive or" operations.

Another important capability of the accumulator is its ability to "rotate" its contents. In an 8008, as in many micros, the contents of the accumulator can be rotated either to the right or left. This capability has many useful functions, and is one method by which mathematical multiplication or division can be performed. Fig. 9 illustrates the concept of "rotating" the contents of the accumulator.

The astute reader may notice that the accumulator rotate capability also enables the accumulator to emulate a "shift register" which can be a valuable function in many practical applications of the computer.

The accumulator serves another extremely powerful function. When certain operations are performed with the accumulator the computer is capable of examining the results and will then "set" or "clear" a special group of "flags." Other instructions can then test the status of the special "flags" and perform operations based on the particular setting(s) of the "flags." In this manner the machine is capable of "modifying" its behavior when it performs operations depending on the results it obtains at the time the operation is performed!

In an 8008 based computer, there are four special flags which are manipulated by the results of operations with the accumulator (and in several special cases by operations with "partial accumulators"). These four flags are described in detail below. Other micros have similar condition flags.

The "carry flag" can be considered as a one bit (cell) extension of the accumulator register. This flag is changed if the contents of the accumulator should "overflow" during an addition operation (or "underflow" during a subtraction operation). Also, the "carry bit" can be utilized as an extension of the accumulator for certain types of "rotate" commands.

The "sign flag" is set to a logic state of "1" when the most significant bit (MSB) of the accumulator (or partial accumulator) is a "1" after certain types of instructions have been performed. The name of this flag derives from the concept of using two's complement arithmetic in a register where the MSB is used to designate the sign of the number in the remaining bit positions of the register – conventionally, a "1" in the MSB designates the number as a "negative" number. If the MSB of the accumulator (or partial accumulator) is "0" after certain operations, then the "sign flag" is zero (indicating that the number in the register is a positive number by two's complement convention).

The "zero flag" is set to a logic state of "1" if all the bits in the accumulator (or partial accumulator) are set to zero after certain types of operations have been executed. It is set to "0" if any one of the bits is a logic one after these same operations. Thus the "zero flag" can be utilized to determine when the value in a particular register is zero.

The "parity flag" is set to a "1" after certain types of operations with the accumulator (or partial accumulators) when the number of bits in the register that are a logic one is an even value (without regard to the positions of the bits). The "parity flag" is set to "0" after these same operations if the number of bits in the register that are a logic one is an odd value (1, 3, 5 or 7). The "parity flag" can be especially valuable when data from external devices is being received by the computer to test for certain types of "transmission errors" on the information being received.

In its simplest form, a group of switches can be used as an input device and a group of lamps as an output device!

In addition to the full accumulator previously discussed there are six other 8 bit registers in the Intel 8008 computer referred to as "partial accumulators" because they are capable of performing two special functions normally associated with an accumulator (in addition to simply serving as temporary storage registers). The full accumulator will often be abbreviated in this manual as "ACC" or "register A." The six "partial accumulators" will be referred to as "registers B, C, D, E, H and L."

Registers B, C, D, E, H and L of an 8008 are all capable, upon being directed to do so by a specific instruction, of either incrementing or decrementing their contents by one. This capability allows them to be used as "counters" and "pointers" which are often of tremendous value in computer programs. What makes them especially valuable in 8008 architecture is that when their contents are incremented or decremented the immediate results of that register will affect the status of the "zero," "sign," and "parity" flags discussed above. Thus it is possible for the particular contents of these registers to affect the operation of the computer during the course of a programs operation and they can be used to "guide" or modify a sequence of operations based on conditions found at the actual time a program is executed.

It should be noted that registers B, C, D, E, H and L are capable of being incremented and decremented – but the full accumulator – register A – cannot perform those two functions in the same manner. (The full accumulator can be incremented or decremented by any value by simply adding or subtracting the desired value. There is not, however, a simple increment or decrement by one instruction for use with the full accumulator of an 8008!)

Two of the partial accumulators, registers H and L, serve an additional purpose in the 8008 computer CPU. These two registers can be used to directly "point" to a specific word in memory so that the computer may obtain or deposit information in a different part of memory than that in which a program is actually being executed. The reader should recall that a special part of the central processor unit (CPU) termed the program counter is used to tell the computer where to obtain the next instruction while executing a program. The program counter was effectively a "double word length" register that could hold the value of any possible address in memory. The program counter is always used to tell the machine where to obtain the next instruction. However, it is often desirable to have the machine obtain some information – such as a "data word" – from a location in memory that is not connected with where the next instruction to be performed is located. This can be accomplished by simply loading "register H" with the "high address" (page) portion of an address in memory, then loading "register L" with the "low address" portion of an address in memory, and then utilizing one of a class of commands that will direct the CPU to fetch information from or deposit information into the location in memory that is specified ("pointed to") by the "H" and "L" register contents. This information flow can be from/to the location specified in memory and any of the CPU registers.

At this time it would be beneficial for the reader to study Fig. 10. Fig. 10 is an expanded block diagram of Fig. 2(b) and shows the units of the computer which have been presented in the previous several pages.

Until now no mention has

Fig. 9. Rotating the content of the accumulator.

B7	B6	B5	B4	B3	B2	B1	B0	
0	0	0	0	0	0	1	0	ORIGINAL CONTENTS OF THE ACCUMULATOR (EQUAL TO DECIMAL 2)
0	0	0	0	0	1	0	0	RESULT WHEN THE ACCUMULATOR IS ROTATED TO THE LEFT ONE TIME (VALUE NOW EQUAL 4)
0	0	0	0	0	0	0	1	RESULT WHEN THE ACCUMULATOR IS NOW ROTATED TO THE RIGHT TWO TIMES (VALUE NOW EQUAL 1)
1	0	0	0	0	0	0	0	NOTE THAT IF A ROTATE RIGHT COMMAND IS DONE AGAIN THAT THE "1" IN POSITION B 0 WILL APPEAR AT B 7 !!
0	0	0	0	0	0	0	1	AND THAT NOW A ROTATE LEFT COMMAND WOULD RESTORE THE "1" IN POSITION B 7 BACK TO B 0 !

It has been said that the computer is the most versatile machine in existence and that its applications are limited only by man's ability to develop programs that direct the operation of the machine.

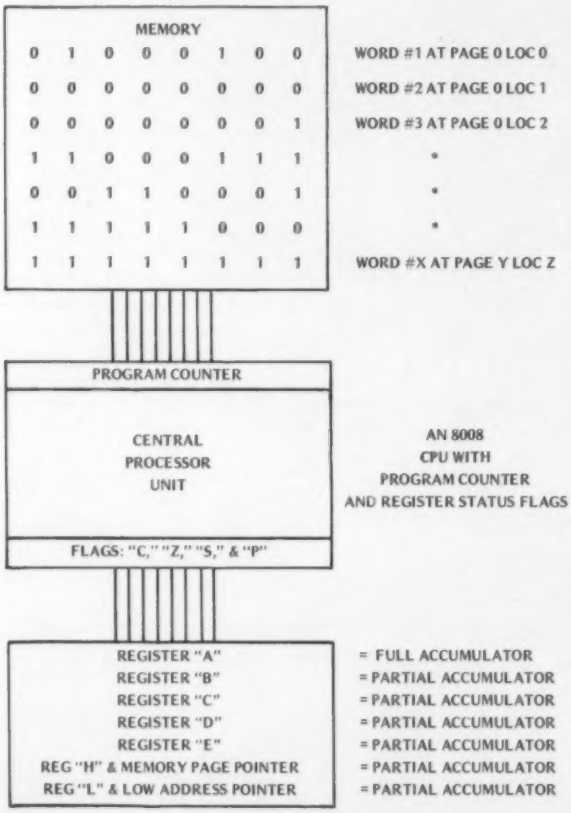
The computer's great versatility comes about because the machine is capable of executing a large group of instructions in an essentially limitless series of combinations.

been made of how information is put into or received from a computer. Naturally, this is a very vital part of a computer because the machine would be rather useless if people could not put information into the machine upon which calculations or processing could be done, and receive information back from the machine when the operations(s) had been performed!

Communications between the computer and external devices — whether those devices be simple switches, or transducers, or teletype machines, or cathode-ray-tube display units, or keyboards, or "mag-tape" and "disk" systems — or whatever, are commonly referred to as input/output operations and are collectively referred to in abbreviated form as "I/O" transfers.

In the Intel 8008 computer designs all "I/O" transfers are typically made between external "I/O ports" (which connect to external devices via appropriate electronic connections) and the full accumulator in the computer. This I/O structure means that a whole group of devices can be simultaneously hooked up to the computer and the computer used to receive information from or transmit information to a variety of devices as directed by a "program." A special set of commands is used to instruct the computer as to which "I/O port" is to be operated at any particular instant. With appropriate programming it is then possible to have the computer "communicate" with a large variety of devices in an essentially "automatic" mode — for instance receiving information from a digital multimeter at specified times, then possibly performing some averaging calculations, and then outputting results to a teletype machine without human intervention. Or, in other applications — information from a human operator can be typed into the machine using a typewriter-like keyboard. In its simplest form, a group of switches can be used as an input device and a group of lamps used as an output device for the computer!

Fig. 10. The block diagram of Fig. 2(b) filled in with the designations for an Intel 8008 computer.


MEMORY
0 1 0 0 0 1 0 0
0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 1
1 1 0 0 0 1 1 1
0 0 1 1 0 0 0 1
1 1 1 1 1 0 0 0
1 1 1 1 1 1 1 1
WORD #1 AT PAGE 0 LOC 0
WORD #2 AT PAGE 0 LOC 1
WORD #3 AT PAGE 0 LOC 2
*
*
*
WORD #X AT PAGE Y LOC Z
PROGRAM COUNTER
CENTRAL PROCESSOR UNIT
FLAGS: "C," "Z," "S," & "P"
AN 8008 CPU WITH PROGRAM COUNTER AND REGISTER STATUS FLAGS
REGISTER "A"
REGISTER "B"
REGISTER "C"
REGISTER "D"
REGISTER "E"
REG "H" & MEMORY PAGE POINTER
REG "L" & LOW ADDRESS POINTER
= FULL ACCUMULATOR
= PARTIAL ACCUMULATOR
= PARTIAL ACCUMULATOR
= PARTIAL ACCUMULATOR
= PARTIAL ACCUMULATOR
= PARTIAL ACCUMULATOR
= PARTIAL ACCUMULATOR

Perhaps the most wonderful and exciting aspect about a digital computer is its tremendous versatility. It has been said that the computer is the most versatile machine in existence and that its applications are limited only by man's ability to develop programs that direct the operation of the machine. It is undoubtedly one of the best machines for allowing man to exercise and test his creative powers through the development of programs that direct the machine to perform complex operations that can not only control other machines, or perform calculations many times faster than humanly possible, but because it can be used to "simulate" or "model" other systems that it might be impractical to build for purely experimental purposes. Thus man can create a "model" in a computer program and actually "play" with the synthetic model without actually building the physical device!

The computer's great versatility comes about because the machine is capable of executing a large group of instructions in an essentially limitless series of combinations — these series of instructions are stored in the memory bank(s) of the computer — and a new series of instructions can be placed in the memory bank(s) whenever desired. In fact, the memory bank(s) can often hold several completely unrelated "programs" in different sections and thus one can have a machine that performs totally unrelated tasks simply by pushing a few buttons and thereby directing the machine to start executing a new program in a different section of memory!

The digital computer is capable of providing services to people from all walks of life! A person need only choose (or develop) programs and connect external instruments that will provide the capabilities desired.

For instance, a scientist might put a mathematical calculator program into the

computer's memory and use the computer as a sophisticated electronic calculator by using a calculator-type keyboard as an input device and a CRT display as an output device on which to receive the answers to complex mathematical calculations which the computer performs. After using the computer as a calculator for a period of time, the scientist might decide to utilize the same computer to automatically record data from instruments during an experiment. By simply putting a different program in the computer's memory and plugging some peripheral measuring instruments into the computer's I/O ports, the scientist could have the computer periodically make measurements while he went out to lunch and save the results in its memory. After lunch the scientist could have the computer tabulate and present the data obtained from the experiment in compact form. Then, by merely putting a different program in the memory, the scientist could have the computer help him set up and arrange a "reference file" all sorted into alphabetical order or any manner that would enable him to use the computer to extract information far faster than a manually operated "paper file card" system.

So the computer can be a valuable tool for a scientist; but, the same machine with a different program in its memory (and possibly different peripheral devices) could be used to control a complex manufacturing operation such as a plastic injection molding machine. In such a case I/O units that coupled to transducers on the injection molding machine might be used to relay information to the computer on a variety of parameters such as temperature of the plastic in the feed barrel, amount of feed material in the hopper and injection barrel, available pressure to the mold jaws and feed barrel, vacancy or filled status of the mold and other useful parameters. The computer could be programmed to analyze this information and send back signals to control the operation of heaters, pressure valves, the feed rate of raw materials, when to inject plastic into the mold, when to empty the mold, and other operations to enable the plastic injection system to operate in an essentially automatic mode.

Or, a businessman could use the same computer connected to an electric typewriter, with a suitable program in memory, to compose, edit and then type out "personalized form letters" by directing the computer to insert paragraphs from a "bank of standard paragraphs" so as to form a personalized customer answering system that would handle routine inquiries in a fraction of the time (and cost) that it would take a secretary to prepare such letters. Or, the businessman might utilize the computer to help him control his inventory, or speed up his accounting operations.

However, a computer that costs as little as the typical micro system does not have to be restricted to a business or scientific environment. The computer that can do all the types of tasks mentioned above can also be used to have fun with, or to perform valuable services, to private individuals.

The computer can be used as a sophisticated electronic calculator by almost anyone. It can be used to compose letters (using an editor program) by virtually anyone. Programs that sort data alphabetically or in various other categories can be of valuable service to people in many applications. The computer can be used to monitor and control many household items, serve as a security monitoring system, be connected to devices that will dial telephones, and do thousands of other tasks.

The electronic hobbyist can be kept occupied for years with a digital computer. For instance, one can build a little test instrument that plugs into a few I/O ports on the computer, then load programs into memory that will direct the computer to automatically test electronic components (such as complex TTL integrated circuits) in a fraction of a second! (Businesses can do this too!)

Or a ham radio operator can put a program into memory that will enable the computer to receive messages typed in from a keyboard, convert the messages to Morse code, and then actuate an oscillator via an output port to send perfectly timed Morse code. In addition, the ham radio operator might use the computer with an appropriate program to serve as a "contest logging aid." The "logging aid" would serve as an instant reference file whereby the operator could enter the calls of stations as they were worked and have the computer verify if the contact was a duplicate. The computer could do other tasks too, such as record the time of the contact by checking an external digital clock (or by utilizing a program that would enable the computer to be used as a clock within itself)!

And, the computer can be used to play numerous games with, such as tic-tac-toe, checkers, word games, card games, and a large variety of other types of games that one can program a computer to perform.

And perhaps most important – for the student, hobbyist, scientist, businessman, or anyone interested in the exciting possibilities of its applications – the contemporary microcomputer offers unlimited possibilities for the expression of individual creativity. For the development of computer programs can be an extremely creative, exciting and personally rewarding pastime and offers essentially limitless ways to exercise one's creative capabilities in developing "algorithms" that will enable the machine to perform desired tasks!

The development of computer programs can be an extremely creative, exciting and personally rewarding pastime and offers essentially limitless ways to exercise one's creative capabilities . . . .

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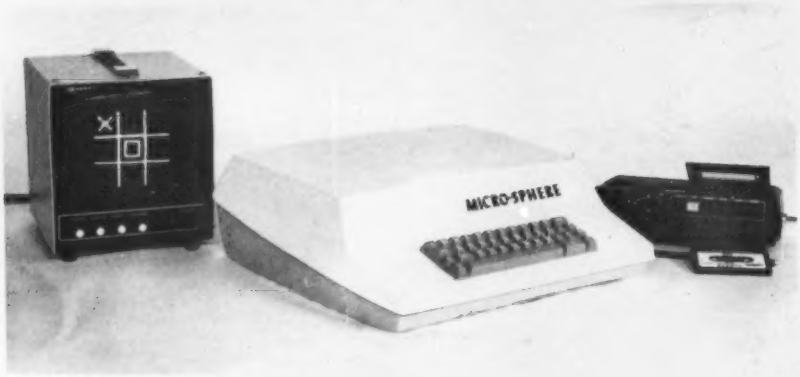

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ADC	Add with Carry
ADD	Add
AND	Logical And
ASL	Arithmetic Shift Left
ASR	Arithmetic Shift Right
BCC	Branch if Carry Clear
BCS	Branch if Carry Set
BEQ	Branch if Equal to Zero
BGE	Branch if Greater or Equal Zero
BGT	Branch if Greater than Zero
BHI	Branch if Higher
BIT	Bit Test
BLE	Branch if Less or Equal
BLS	Branch if Lower or Same
BLT	Branch if Less than Zero
BMI	Branch if Minus
BNE	Branch if Not Equal to Zero
BPL	Branch if Plus
BRA	Branch Always
BSR	Branch to Subroutine
BVC	Branch if Overflow Clear
BVS	Branch if Overflow Set
CBA	Compare Accumulators
CLC	Clear Carry
CLI	Clear Interrupt Mask
CLR	Clear
CLV	Clear Overflow
CMP	Compare
COM	Complement
CPX	Compare Index Register
DAA	Decimal Adjust
DEC	Decrement
DES	Decrement Stack Pointer
DEX	Decrement Index Register
EOR	Exclusive OR
INC	Increment
INS	Increment Stack Pointer
INX	Increment Index Register
JMP	Jump
JSR	Jump to Subroutine
LDA	Load Accumulator
LDS	Load Stack Pointer
LDX	Load Index Register
LSR	Logical Shift Right
NEG	Negate
NOP	No Operation
ORA	Inclusive OR Accumulator
PSH	Push Data
PUL	Pull Data
ROL	Rotate Left
ROR	Rotate Right
RTI	Return from Interrupt
RTS	Return from Subroutine
SBA	Subtract Accumulators
SBC	Subtract with Carry
SEC	Set Carry
SEI	Set Interrupt Mask
SEV	Set Overflow
STA	Store Accumulator
STS	Store Stack Register
STX	Store Index Register
SUB	Subtract
SWI	Software Interrupt
TAB	Transfer Accumulators
TAP	Transfer Accumulators to Condition Code Reg.
TBA	Transfer Accumulators
TPA	Transfer Condition Code Reg. to Accumulator
TST	Test
TSX	Transfer Stack Pointer to Index Register
TXS	Transfer Index Register to Stack Pointer
WAI	Wait for Interrupt

MPU INSTRUCTION SET

The MC6800 has a set of 72 different instructions. Included are binary and decimal arithmetic, logical, shift, rotate, load, store, conditional or unconditional branch, interrupt and stack manipulation instructions.

MPU ADDRESSING MODES

The MC6800 eight-bit microprocessing unit has seven address modes that can be used by a programmer, with the addressing mode a function of both the type of instruction and the coding within the instruction.

Accumulator (ACCX) Addressing

Immediate Addressing

Direct Addressing

Extended Addressing

Indexed Addressing

Implied Addressing

Relative Addressing

The Micro-Sphere 200 Series computer is the most ADVANCED, low-cost computer SYSTEM available today. Together with a TV and up to three cassette recorders you can have big computer performance at a rock bottom price.

The system features a 6800 type micro-computer with 4000 characters (4K Bytes) of internal Random Access Memory (RAM) Storage. The memory is easily expandable to 8000 total characters with the addition of an optional second 4K of RAM, with even more memory to be made available shortly. The 4K bytes of memory is equivalent to 6-8 pages of close typewritten material.

Access into the Micro-Sphere is achieved by the keyboard or from cassette recorders. The computer can display information on a standard TV screen (optionally supplied) or store information on a cassette recorder.

The keyboard uses highly reliable keyswitches to insure user satisfaction. It is full alpha-numeric including an integrated numeric key pad. The cassette interface uses the "Kansas City" standard which means that you can use even the least expensive cassette recorders with your system satisfactorily though we suggest that you do use high quality tapes with your system.

You may use your own TV without modification as the system display device, or you may purchase one from Sphere.

The power requirement is a single 110 volt AC outlet. The unit uses less power than an ordinary 100 watt light bulb. All fuses, jacks, switches, and interface signals are provided on an easy-access panel at the rear of the cabinet.

The Micro-Sphere is supplied with a built-in loading program from cassette, which is in one of the several standard or optional Read Only Memory (ROM) Integrated Circuits (IC). ROM IC's are pre-programmed with specific non-eraseable information. This feature greatly reduces program loading time and inconvenience, ROM's also save valuable RAM storage. RAM's lose all stored memory whenever the computer power is turned off, while ROMs retain all programs indefinitely.

The Micro-Sphere is unique in that 16,384 different dots on your TV screen can form any number of pictures or designs which you have instructed your computer to display. These images can be changed by the computer program at a rate that appears as real-life movement, such as aircraft flight simulation, "walk-through" inspection of architectual mock-ups, time-lapse stock market graphic analysis, or even computer generated art forms, or space flight simulation where you can guide your spacecraft to the moon, planets or the universe.

You can experience the thrill of rolls, dives, loops, near-collisions and other types of aerial maneuvers to out wit the Red Baron in your Sopwith Camel and then the excitement of a victorious landing as you crash at the end of the approaching runway.

This same 128 row by 128 column dot matrix can form an alpha-numeric display of up to 16 lines by 21 characters. An optional graphics input device (Mouse) digitizes hand movements when moved about on a flat surface. The "Mouse" has a window and crosshairs, so it may be used for the accurate entry of maps or other graphic data. The mouse may also be used in the place of a joy stick for flight simulation or to enter hand movements for ping-pong or other games of skill.

Sphere Corp. has included in the basic price of the Micro-Sphere 200 the Monte Carlo games package on cassette, which allows you to play blackjack, roulette, and other games just for fun.

The Sphere Cassette Operating System (SCOS) is supplied on tape and provides Assembler, Edit, and Debugging functions to the computer when read in to RAM from the Cassette. Sub-routines for floating point and trig functions are included in the SCOS cassette and may also be purchased as an option in ROM. Sub-routines are included in SCOS which provide all necessary alpha-numeric character generation for your TV using approximately 400 bytes of RAM. An optional character generator ROM can be purchased to reduce RAM usage to 50 bytes. SCOS also supports file handling.

If the second 4K of RAM is purchased the macro facility of the assembler is then available as an extended aid to help you in the development of your own programs. The second 4K of RAM will also allow you to read in extended Business Basic from cassette. This basic provides 16 digits of decimal accuracy and extensions for business use. This Business Basic can make use of the Floating Point and Trig Package in RAM or ROM to expand its capabilities into the engineering field. The Business Basic and Trig Packages are available in ROM, which leaves all of the RAM storage available for applications written in the Basic Language. This is a concept for which you may pay $9,000 to get from an IBM 5100 computer.

One Cassette recorder is sufficient to do everything by simply changing tapes. Multiple file handling such as inventory control, pay roll, and general ledger processing etc. will be more convenient if two or even three cassette recorders are used. For example tape #1 may contain the last year-to-date accumulation file, tape #2 may contain the present pay period account, while tape #3 is used to combine tapes #1 and #2 into a new year-to-date accumulation master file. The second and third Cassette Interface options are available for those who require them.

In the near future, Sphere will release a Programmable Input/Output Controller for use with printers, disks, and other input/output devices.

The attractive two-tone case is made of mar-resistant high impact plastic designed to fit any modern decor. Additional strength and protection to components is provided by an internal metal chassis.

The unit is designed to operate in a normal home or office environment without any extra care. The Micro-Sphere is the product of many years of experience in the micro-computer field, providing a tremendous amount of power and capability in the smallest space-it requires only a small desk with space left over, and it comes fully assembled and tested--ready to use.

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PRICES FOR MICRO-SPHERE 200 WITH OPTIONS

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	"A" ITEMS: 6800 type Micro-Processor unit; 4K of Memory (RAM); Cassette Loading System (ROM); Sphere Cassette Operating System (SCOS) Cassette 1 time license fee @ $137.50		
	Includes Floating Point and Trig Package — Cassette copy @ 12.50	$150.00	Incl.
	Monte Carlo Games Package (Cassette)	$10.00	Incl.
	First Cassette Interface; 128 by 128 B&W Dot Matrix Graphics Display; Alpha-Numeric Keyboard; Attractive Mar-Resistant Plastic Case; Operators Manual		
	OPTIONS AVAILABLE THROUGH FACTORY INSTALLATION. * To install options after purchase is $35.00 per shipment to our plant.		
	"B" ITEMS: Second 4K of memory (RAM)	$180.00	$180.00
	Character Generator (ROM)	$25.00	$25.00
	"C" ITEMS: Second Cassette Interface	$50.00	$50.00
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	Maintenance Manual	$40.00	$40.00
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by
C. Warren Andreasen WA6JMM
P.O. Box 8306
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A Versatile TTY Generator

A short time ago, an old Model 15 Teletype machine was, so to speak, left on my doorstep. I wanted to see it do something, and was not satisfied with pounding on the keyboard. Since I did not have the proper terminal unit and receiver combination to copy off the air, I asked myself what kind of a simple test device could be made that would make the machine print. I set to work thinking that an RY generator should not be too hard, but much to my surprise I came up with a nifty little unit which is inexpensive to build and yet will print every key and function on the Teletype machine. Not only will it print a test pattern testing *all* figures and letters, but it will also take an input from an external source, such as a memory device, and will generate useful TTY signals. With a simple interface, this unit may be run directly from a solid state keyboard.

The scope of this article will be to present a basic TTY generator which is not only a useful test generator, but may also be expanded into a complete transmission system with memory.

The heart of the system is a data selector (IC-5), and counter (IC-2&3). The data selector has eight inputs and one output. The output is connected to any one of the inputs, and the selection is done by the BCD code applied to the selection inputs. If the BCD code 000 is applied, the output is connected to input X0. If the BCD code is 100, input X1 is selected, and so on. The counter is an eight bit counter consisting of a CD4024 7 stage counter, and ½ of a CD4013, adding the 8th stage. This counter is stepped by the output of an oscillator which steps the counter every 22 ms (refer to Fig. 1). The first three stages, Q1, Q2 and Q3, are connected to the selection inputs of the data selector, causing the output to scan each input at a rate of one input each 22 ms. The inputs of the data selector are wired so that X0 is always low, X1 is always high, and X7 is always low. This leaves inputs X2-X6 open for data. For ease of explanation, we will assume the open inputs are low, the counter has been sitting, reset, at count zero. Input X0 is selected causing the output of the data selector to be low (mark). The oscillator and counter are enabled and 22 ms later input X1 is selected causing 22 ms of high (space), the start pulse, to be output. Since the next five inputs are low (assumed) the next 110 ms (5 x 22 ms) will be low (mark). Now the 8th input is selected and it is always low. If the circuit as described were allowed to continue to run, each cycle would consist of 22 ms of space and 154 ms of mark. If this were applied to a Teletype machine, the repeated LTR function would be observed. If the five (X2-X6) data inputs were

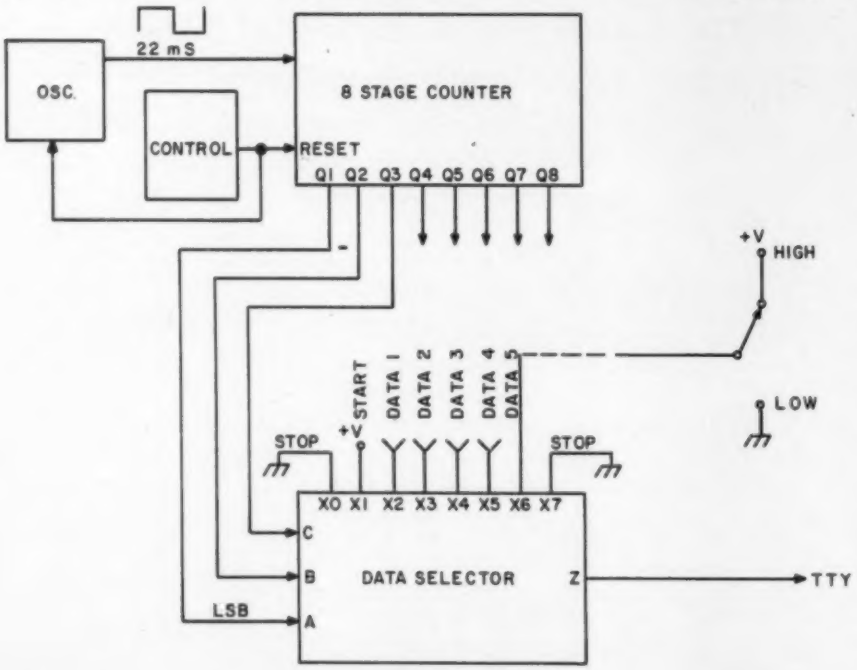

Fig. 1.

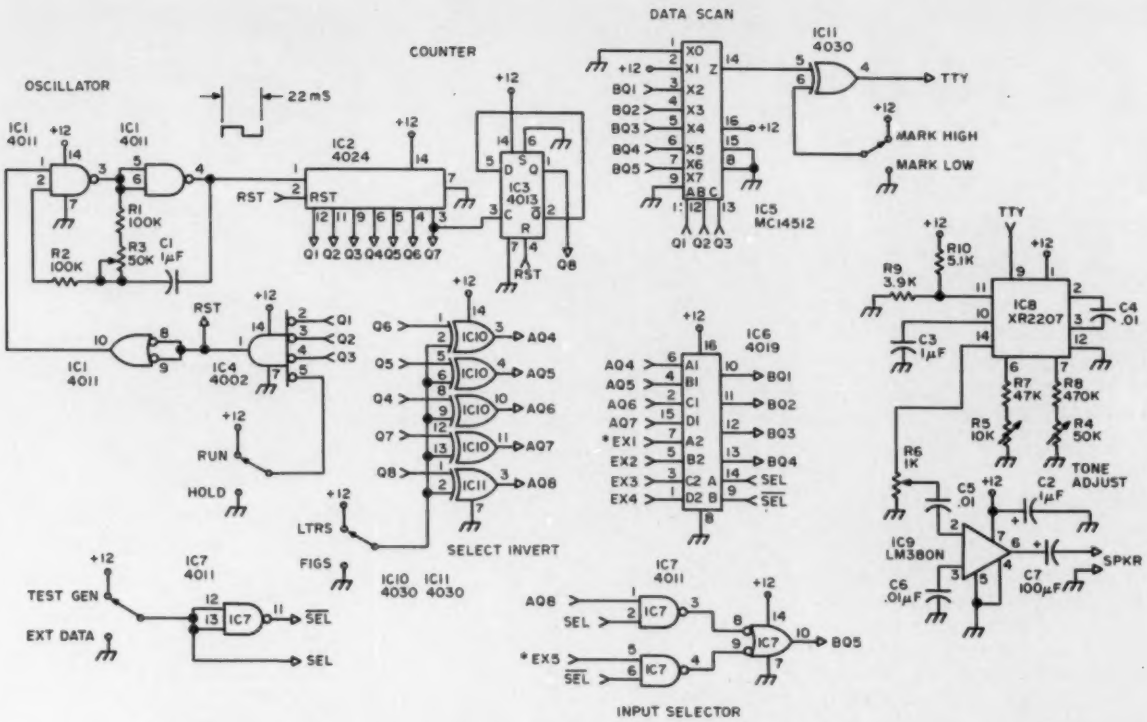

*Fig. 2. *Note: Terms EX1-EX5 have no source, but are provided as inputs for external data, or switches.*

connected to switches so that a high or low could be placed on each input, each combination of the switch settings would produce a different character or function. Going a step further, we will now connect each of the five data inputs to one of the five remaining counter outputs (Q4-Q8). As can now be observed, each pass, or scan, of the data selector will have a different combination of data for the five data bits. Again, if this were applied to a Teletype machine, it would be observed that each full cycle would consist of every key (every code) being "hit" once. Some of these characters would be upper case, and some lower. It is desirable to have all upper or all lower case characters, and if counter outputs Q4 and Q6 are interchanged, we will get this. As described, the printing would be all upper case (since the letters function is followed by the figures function). If all five bits are inverted, all will be lower case because figures is now followed by letters.

To select which polarity of signal is sent to the data selector from the counter, each bit is passed through an "Exclusive OR" gate, which will be used as an invert select function. The counter bit goes in one input, and the control signal in the other. If the control input is high, the gate will invert and the print will be all letters. If the control input is low, the gate will not invert and all figures will be printed. Now there are two selectable patterns consisting of all letters (entire alphabet), or all figures. In both patterns there is a carriage return and a line feed so the paper does not overprint, but since there is no delay after a carriage return, some machines will print the first letter of the line before the carriage has fully returned, causing a single character overprint.

To add the final touch to this circuit, a data selector will be used to select the data source. If the control signal is low, the five inputs, which can come from anything from static switches to memory, will be selected. If it is high, the internal test pattern data are selected. Also added will be a selectable inverter on the TTY output so mark high or mark low may be selected, and also a simple ASFK oscillator and audio amplifier.

When built with the values shown, this circuit will provide audio tones of 2125 Hz and 2975 Hz, and will drive a loudspeaker to ear-splitting volume. ■

Parts List

IC-1	CD4011	RCA	Quad 2 Input NAND Gate
IC-2	CD4024	RCA	7 Stage Counter
IC-3	CD4013	RCA	Dual D Flip Flop
IC-4	CD4002	RCA	Dual 4 Input NOR Gate
IC-5	MC14512	RCA	8 Input Data Selector
IC-6	CD4019	RCA	Quad AND/OR Select
IC-7	CD4011	RCA	(SEE IC-1)
IC-8	XR2207	EXAR	Voltage Controlled Oscillator
IC-9	LM380N	NAT	Audio Amplifier
IC-10	CD4030	RCA	Quad Exclusive OR
IC-11	CD4030	RCA	(SEE IC-10)
R1-R2	100k ¼ Watt Resistor		
R3-R4	50k Variable Resistor		
R5	10k Variable Resistor		
R6	1k Variable Resistor		
R7	47k ¼ Watt Resistor		
R8	470k ¼ Watt Resistor		
R9	3.9k ¼ Watt Resistor		
R10	5.1k ¼ Watt Resistor		
C1-C3	1 mF 16 volt Capacitor		
C4-C6	.01 mF Disc Capacitor		
C7	100 mF 16 volt Electrolytic Capacitor		

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The HAL ST-6000 operates at standard shifts of 850, 425, and 170 Hz. The tone keyer is crystal-controlled. Loop supply is internal. Active filters allow flexibility in establishing different tone pairs. You can select AM or hard-limiting FM modes of operation to accommodate different operating conditions. An internal monitor scope (shown on model above) allows fast, accurate tuning. The ST-6000 has an outstandingly high dynamic range of operation. Data I/O can be RS-232C, MIL-188C or current loop.

The DS-3000 and DS-4000 series of KSR and RO terminals provide silent, reliable, all-electronic TTY transmission and reception, or read-only (RO) operation of different combinations of codes, including Baudot, ASCII and Morse. The powerful, programmable 8080A microprocessor is included in the circuitry to assure maximum flexibility for your present needs —and for the future. The KSR models offer you full editing capability. The video display is a convenient 16-line format, of 72 characters per line.

These are some of the highlights. The full range of features and specifications for the ST-6000 and the DS series of KSR and RO terminals is covered in comprehensive data sheets available on request. Write for them now—and tune in to the most sophisticated TTY operation you can have today...or in the future.

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I/O from page 65

of reading of *73* articles (many of which are not even written yet) you will be plain high and dry trying to fathom what these strange folk are trying to say in their weird new language.

My Computer Likes Me (when I speak in BASIC) by Bob Albrecht. Dymax, Box 310, Menlo Park CA; 64 pp., $2.00.

Company. *My Computer Likes Me* is written as a simplified approach for rank beginners, and seems aimed at the secondary school user with a classroom terminal. The approach is friendly, informal and light, with plenty of examples to show every step of the way. Only the fundamentals of BASIC are covered, with a demonstration of mathematical modeling to predict population. For a student with an innate fear of the computer and what it takes to understand one, this simple text is perfect to break down that first barrier.

BASIC (A Self-Teaching Guide) takes a more sober approach and goes much farther. Programmed teaching, with step-by-step questioning of the textbook. But no manufacturer's reference book takes the time to start a new programmer off on the right track without major confusion – unless perhaps he's a genius. For a timid user, *My Computer Likes Me* would be ideal as an appetizer, but *BASIC (A Self-Teaching Guide)* provides a main course for the hungry learner.

What to Do After You Hit Return (or, PCC's First Book of Computer Games). People's Computer Company, Menlo Park CA; 158 pp.

Computers are fantastic toys, and the best thing about them is that they can be made to do so many different things, so you never really get bored. you're so inclined, but the hardware is half the fun, right?

What to Do After You Hit Return is big and attractively put together on giant pages that stay open on the table. It's the software equivalent of a barrel of monkeys. See why most colleges find that most of their computer time is spent playing games!

Games, Tricks and Puzzles for a Hand Calculator by Wallace Judd. Dymax, Box 310, Menlo Park CA 94025; 91 pp., $2.95 + .50 postage and handling.

Even when I read old "fun with math" books I didn't think mathematics was fun. Now I know what was missing. This book updates the old number tricks by using calculators to

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BASIC (A Self-Teaching Guide) by Robert L. Albrecht, LeRoy Finkel, and Jerald R. Brown. Wiley, New York; 324 pp., $3.95.

The most popular computer language for both small systems and time-sharing is BASIC. It is a powerful language, yet easy to learn, and is fast being adopted as the standard language for hobby computer program exchange. The computer novice who purchases a microcomputer will probably want to obtain a BASIC operating system for his computer, as it speeds up programming immensely.

These two textbooks are very different in scope and approach, though both are authored by Bob Albrecht of the People's Computer student, punctuates the text into individual concepts, none of which intimidate the student the way a less cautious text can. After explaining input and output, arithmetic, and simple logical statements, the more sophisticated capabilities of BASIC, such as matrix arithmetic and string (character) operations, are cautiously introduced. After completing the text, the student should feel competent to handle most problems that can be solved with BASIC and a small computer.

No text in programming is really complete without a computer to practice on, and the versions of BASIC that different manufacturers supply are not all identical to any

Especially with this book, which includes fifty different games you can play on a computer that speaks BASIC. These were developed on the Hewlett-Packard 2000 minicomputer system, and the programs were all tested by H-P personnel. Many have been circulating for years; some are quite recent.

There are number games, word games, pattern games, board games, simulations, and even science fiction games. *Nim, Lunar Lander, Star Trek, Madlib, Bagels,* and most other popular computer games are included. Rules are explained, sample runs are shown, and in most cases, program listings are included (in BASIC). Most can be played without a computer if

do the dirty work. Suddenly math *is* fun – with the machine. *Games, Tricks, and Puzzles* ... includes simple mathematical tricks that even children would appreciate, as well as more complicated exercises that require some high school algebra. They are explained in order of complexity.

There are also the calculator "word" games played by turning the calculator upside down, a photo story on how a calculator is made, and information to help evaluate calculators prior to purchasing one. Answers to the puzzles are in back, along with explanations of how they work. Impress your friends. You may even impress yourself!

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Chariots of the Hams?

Anyone who is aware of the history of mankind realizes the enormous engineering capabilities that some of the ancient civilizations held. Both the Greeks and Romans devised ingenious inventions to benefit their respective cultures.

Professor C. Q. Flugalsnort (alias Dan WNØOZW), crack archeologist, checks out an obviously primitive ham rig at the digging site.

But of course we all know that they weren't so advanced as to allow a citizen of Athens to jump into his chariot and key up the local repeater mounted on the nearby Parthenon. And we all know that it would be stupid to expect to find an FET stuck in one of the hoofs of the Trojan Horse. That would be just plain dumb, wouldn't it? Or would it? Better wait to decide until you've read this story of an ancient civilization that may have some lessons for all amateurs!

It all started one clear fall afternoon as our college ham club was holding its annual transmitter hunt and "refreshment hour." One of the guys had already found the transmitter — hanging from a shower nozzle in the fifth floor bathroom of the women's dorm. Tracking down the transmitter hadn't been the toughest part of the hunt — retrieving it from its ingenious hiding place with-

out getting caught was what took guts!

But anyway, it turned out that two of our club members had started their personal "refreshment hour" a few hours before the hunt even started, and had somehow ended up sauntering through a field some 10 miles away from the transmitter. Upon returning to the festivities, they claimed that they had been led astray by some freak harmonics from the airport VOR. But we knew better. To make matters even more ridiculous, they claimed to have tripped over a mike cord coming right out of the ground!

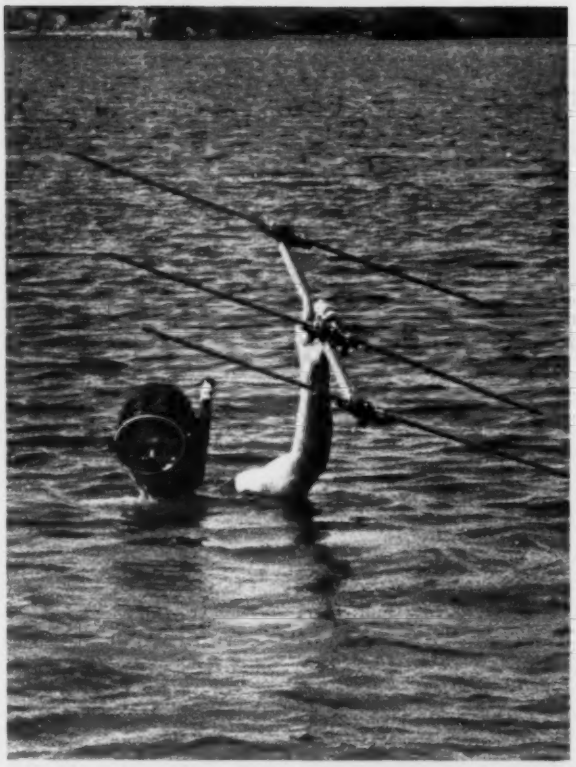
That's right – right out of the ground!

"Sure," we all said, having a nice chuckle over this bit of QRM. But the guys kept insisting that they were telling the truth, and pretty soon the refreshment hour had been in progress long enough for everyone to want to take a look at this place. Needless to say, we tied up the repeater with talk of this on the way out to this field, and also needless to say, every other guy in town listening thought we were nuts.

But sure enough – coming right out of this field was a mobile mike and coiled cord. We quickly checked the club records to see if we had ever had a party out here; no, we hadn't. (The possibility of a rig getting buried at one of our club parties wasn't to be overlooked, although I don't think this is what they were talking about in the recent *73* article on underground radio transmissions.)

The whole thing was so darn funny that pretty soon we had half the hams in town tromping around in this field. Shortly, one of the guys tripped over something about 30 yards away from the mike

Flugalsnort (note puzzled expression on face) checks out mobile mike coming right out of the ground.



Ham scuba diver from our college ham club pulls "fossilized" 2 meter beam out of lake. Was there an ancient civilization of ham operators, and if so, did they disappear because of incentive licensing?

cord coming out of the ground. We all ran over.

"Darn if that doesn't look like a two meter beam," he said, "but it looks like it's fossilized!"

Well, we all had a good laugh over this obvious prank and headed home to recharge our hand-helds and finish the "refreshment hour," which by now was becoming something more like a "refreshment day."

I awoke bright and early at 12 noon the next day to the ringing of the phone. On the line was Professor C.Q. Flugalsnort, our college's crack archeologist. Prof. Flugalsnort had heard from somebody about the strange things discovered in the field the night before. I tried to explain that it all had to be a joke pulled by someone, because one just doesn't find real fossilized two meter beams laying around in cornfields.

But Flugalsnort insisted that we had to go out and take a look. I agreed to meet him at the field, but just as I was leaving the phone rang – it was a member of the club reporting that scuba diving that day in a nearby lake he had come across another fossilized beam! Either somebody was going to an awful lot of effort to get some laughs, or we were really on to something strange.

I rounded up the rest of the club and we headed back out to the field with an assortment of shovels. Not to pass up an opportunity like this, two members of the club were already drawing up proposals to submit to the dean for us to get a full class credit in archeology for digging up

this field. (Which reminds me of the time I tried to get a class credit in physical education for hauling a 20 meter beam up a 75 foot tower alone; I deserved it. But that's another story . . .)

Anyway, Professor Flugalsnort met us at the field. Flugalsnort is the kind of guy who, if you ever saw him coming over your SSTV screen, would cause you to slap the side of your rig to see if something inside was loose.

We dug around in the cornfield for awhile with Flugalsnort on his hands and knees certain that he was about to make the biggest archeological splash since he'd delivered his paper on the plumbing of ancient fountains before a Chicago convention.

As he galloped around, the rest of us were having a difficult time resisting some 20 over S9 laughter. The two guys who had originally discovered the place had just confessed in whispers that it was their little joke on Flugalsnort all along. It seemed to the guys that a little comic revenge was in order on the professor after he had refused to let our club run antenna coax through his office window pane back at school. Seems that he unjustly thought our rigs were causing him TVI problems at home (we checked it out), and to make matters worse, he even drilled the pane himself (just the right sized hole) and hung a sign over it saying, "NO COAX." What a creep.

Well, after digging a bit more we decided that we had had our fun and started to convince the professor to give it up. We had just about accomplished this when suddenly one of our shovels went "clunk" on something in the ground. This was really funny because the guys hadn't mentioned anything about planting something else in the field. We were all too stunned to see the slight grin on Flugalsnort's face as he slowly pulled a large and ancient-looking stone slab out of the ground with the drawing below on it . . . ■

Mysterious drawing on stone slab pulled out of ground at digging site. Does the fellow on the couch resemble a well-known ham editor from New Hampshire hard at work?

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by
Larry Kahaner WB2NEL
4259 Bedford Avenue
Brooklyn NY 11229

The PLL - EXPOSED!

The phase locked loop is not a new concept. But before integrated circuits, the PLL was an expensive and cumbersome device. Using vacuum tubes, chokes, and other "ancient" components, it was a mess.

The simplest PLL consists of three internal units: a phase detector or comparator, low pass filter and voltage controlled oscillator. They are connected in a loop (Fig. 1).

The Phase Detector

A phase detector (also called comparator) monitors the frequency of its input. When a change in phase (therefore frequency) occurs, it will cause a corresponding change in its output voltage. This change of output is immediate and linear. If we watch the output voltage we can tell if a frequency change was happening at the input.

In the crudest form it can be an exclusive OR gate. Fig. 2 shows the inputs and corresponding outputs. (See July, 1975, "How Gates Work," for details on the exclusive OR gate.) The action of the RC network on the output yields the error voltage.

The Low Pass Filter

The action of a low pass filter is well known. Suffice it to say that PLLs have provisions for parts of the filter to be internal and others to be external. For example, the 565 chip has an internal resistor and external capacitor forming the filter.

The Voltage Controlled Oscillator

The VCO is a complex device. As the name implies, it is an oscillator. Its task is to change its output frequency when input voltages change, the opposite of the phase detector. The output frequency will increase as the input voltage increases. To do this, however, the input voltage must increase past a known value called the "threshold voltage." The input is then known as the "control voltage." With no input it operates at a "free running" frequency (f_o) determined by external adjustments.

The Set Up

Here is what happens. If the input frequency changes, the output of the phase comparator increases or decreases. This voltage change is fed through the filter which eliminates extraneous noises and passes the signal to the VCO. This change at the VCO input will alter the output frequency such that its value will be closer to the free running frequency. And the system goes 'round and 'round until the loop is locked on the incoming signal. Reinforcement takes place.

In other words, we set the PLL to search for a certain frequency. When that special frequency is seen, the system works to keep it locked in. The error voltage is then zero and the PLL output goes low. (Does the name phase locked loop make sense now?)

Obviously, the input source, whatever it is, is independent of the PLL, but the action is such that the signal we desire is there even if it disappears for short periods of time. It works as a "flywheel effect" does. How long can it disappear and still have a locked condition? Or, to put it another way, how long does it take to realize the desired signal is there and lock on it? This is related directly to the natural frequency of the loop. The lower it is the longer the lock up time. It is therefore a function of the low pass filter. We adjust the filter for our conditions depending upon how fast our information is. If we are transmitting very fast information, we must have a fast lock up time. If the lock up time is too great (meaning slow), we will lose too much data while our loop is taking its time locking up. Less information speed gives us a greater leeway. It's a tradeoff. We want our filter as low as possible to exclude unwanted noises in our loop circuit, yet fast enough to keep all information intact.

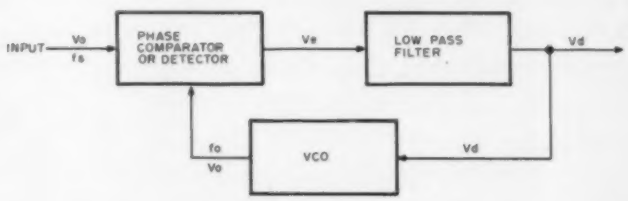

Fig. 1. Phase locked loop.

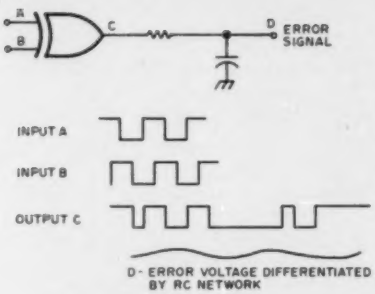

Fig. 2. Exclusive OR gate as a phase comparator.

When the input frequency (f_s) is close to the free running frequency (f_o), the VCO will synchronize and lock. But how close must they be? Just how large is this "capture range"? On most PLLs it is adjustable. It is a function of the input voltage, free running frequency and low pass filter. Equations for figuring capture range are given in PLL specs. Other names which are used are "acquisition range" and "bandwidth."

Once the loop is locked, how far can the input stray before it loses lock? This feature known as "lock range" is larger than the capture range. Once the loop is locked, the input can wander quite a way (relatively speaking) before the PLL will lose its grip. It is also called the "tracking" or "holding" range. The lock range is usually given as a percentage of the frequency. The larger the percentage, the further the input can move before the PLL unlocks. Again, very exact and easy equations are supplied in specs to compute the tracking range.

As an example, we might design a PLL to look for a touchtone signal. We would keep in mind that the capture range must be wide enough to accommodate those signals that might be slightly off frequency but still narrow enough to prevent the wrong numbers from activating our device.

Tracking range would not figure very heavily (again, relatively speaking) in our design as the tones must only be detected for a short time to be effective.

Applications

As we said before, the output dc level of the phase comparator is proportional to the frequency of the input signal at lock. As the frequency shifts, the signal to the VCO changes linearly. If we can track over a large area (about ± 60%) with linearity, we have *FM demodulation.*

The 565 is a good PLL to look at (Figs. 3, 3a). The free running frequency is determined by $f_o = \frac{1}{4} R_1 C_1$. It is adjusted for the center of the input signal frequency range. The 565 also has an amplifier to increase gain of the loop – a good feature. C_3 prevents unwanted oscillations by inhibiting any feedback to the power source. The reference voltage (pin 6) is a voltage close in value to the average dc output of the demodulated signal. By connecting it to the output we can lower the gain of the loop with very little loss of output amplitude. Since the lower the gain the smaller the lock range, we can decrease the lock range without leaving too small an output to use.

C_2 is the low pass filter capacitor. It is coupled with an internal resistor of 3.6k.

Frequency Multiplication

Frequency multiplication using PLLs is easier than you may suspect. There are two methods in use. The first requires that the PLL be set to look for an harmonic of our input. If we set the VCO for the second harmonic of a signal, the completed loop will lock onto it. For all intents we have multiplied a frequency. Of course we are limited to signals rich in harmonics. We are also held captive to the first few harmonics as harmonic strength decreases with harmonic number. Loop amplification is always used in this case.

The second method is also not difficult but does require some extra equipment. Insert a frequency divider between the VCO and phase comparator. The divided VCO frequency is locked to the input. Therefore, the VCO is running at the multiple of the input frequency. The multiple depends upon the divider value. The frequency limits of the inputs must be taken into consideration with both of these procedures. (Fig. 4.)

Frequency Synthesis

PLLs have made low cost, compact FM frequency synthesis a reality. In its simplest state (Fig. 5), a multiplier is used at the input. The PLL is used as an adding device because it has a very important characteristic which others lack – stability. By setting the loop to stringent criteria, the output can be kept to close tolerances with accuracy. The input (f_{ref}) reference frequency is supplied by a crystal oscillator. By adjusting a counter or similar divider we can select or "program" a choice of frequencies. The low

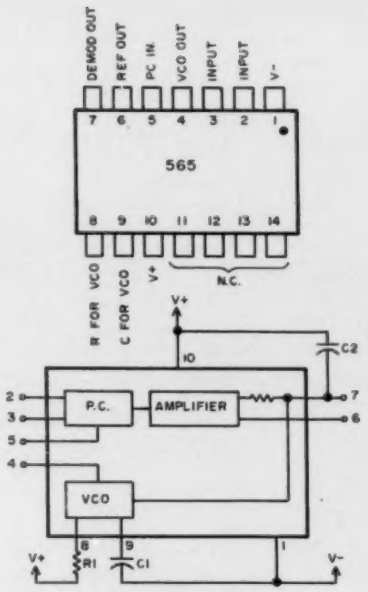

Fig. 3. 565 PLL chip.

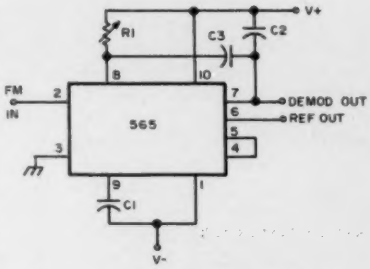

Fig. 3a. 565 PLL as an FM demodulator.

pass filter gets rid of the $f_o + f_{ref}$ component which exists.

I hesitate to give exact block diagrams of synthesizers as work still continues on their design. I have seen and used many good ones, both home brew and commercial. But all leave something to be desired. This is not meant to be a criticism but a push for all experimenters to improve on current designs.

AM Detection

PLLs can also be used for AM demodulation. By using a special VCO or RC phase shifter network and another phase com-

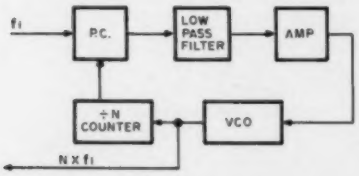

Fig. 4. Frequency multiplication.

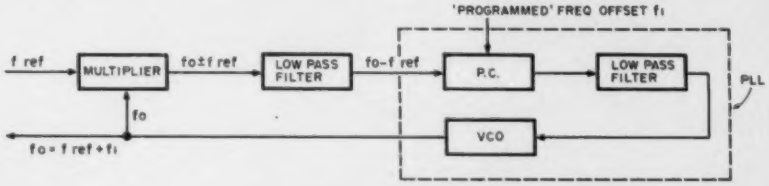

Fig. 5. Frequency synthesis.

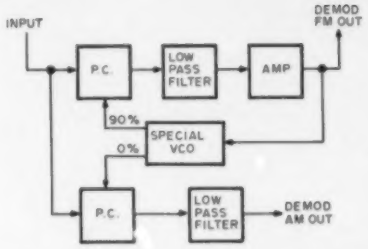

Fig. 6. AM detection using second internal phase comparator.

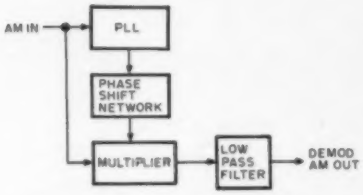

Fig. 6a. AM detection using external phase shift network.

parator, we can demodulate amplitude modulation. Internal operation is shown in Fig. 6 where the VCO output of 90° is changed to 0°. Or as in Fig. 6a where a whole new phase shift network is used. The 561 chip has an internal capability for AM detection along with its FM capability.

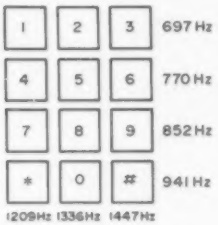

Fig. 8. Touchtones.

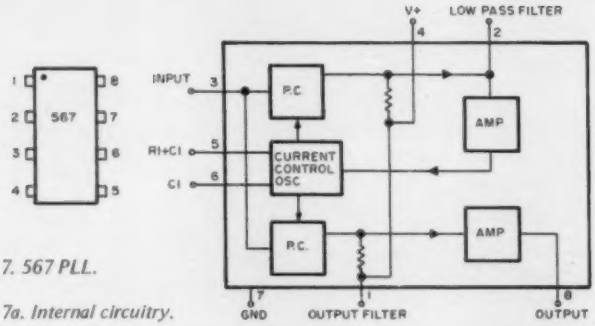

Fig. 7. 567 PLL.

Fig. 7a. Internal circuitry.

With the basic knowledge of the PLL, let's show how a touchtone decoder can be designed.

In order to fully design any system, all available information is needed. In this case, only the sections of the spec sheet which are necessary to this problem will be shown. Keep in mind that a lot more data is available to the user by the manufacturer.

The 567 PLL has shown to be ideal for touchtone decoding. Fig. 7 shows the layout. The "inside" view is given in Fig. 7a.

As you may already know, each digit delivers TWO tones simultaneously when pressed. Each row has a frequency and each column has a frequency. When a digit is pressed the two combine for our signal. A frequency chart is given in Fig. 8. It is therefore necessary to have two PLLs for each digit. There are a total of seven different tones. To decode the number "1" our PLLs must detect 697 Hz and 1209 Hz. The circuit is shown in Fig. 9.

The values of R_1 and C_1 are figured first. They determine the frequency of the loop. The equation is $f_o = 1/R_1 C_1$. According to the specs, R_1 should reside between 2k and 20k for best stability. In our case the top PLL will decode the 697 component, so good values might be R_1 = 6.8k and C_1 = .1 mF. To get the frequency right on the mark (our values yield 680 Hz), a potentiometer near the value of R_1 would serve nicely. Since all components have tolerances trial and error is the rule.

C_2 is part of the low pass filter. For this we use a graph supplied by the manufacturer. The graph in Fig. 10 shows bandwidth versus amplitude.

Decide the bandwidth you desire; find the input signal amplitude and pick off the value of f_oC_2. The equation for bandwidth is BW = 1070 x input voltage/f_oC_2; for inputs not greater than 200 mV, f is in Hz and C is in mF. Again, trial and error may be easier than the arithmetic.

If the input is 50 mV, f_oC_2 should equal 4.1 x 10^3 (4100) for a bandwidth of 4%. Therefore, C_2 would equal approximately 5.9 mF at 697 Hz. As we increase the tone values C_2 would get smaller because 4% of 1477 is larger than 4% of 697 Hz.

The next value is that of C_3. It sets the band edge which attenuates spurious outputs. Hence the name — output filter capacitor. If too small, it will allow frequencies near the detection range to beat against the output frequency and switch the output on and off. If too large, switching time at the output will be delayed as it charges. By experience it turns out to be equal to twice the value of C_2 or a bit more.

To make a touchtone decoder for all digits use the same techniques shown here. You may want to trade off values to get an average capacitor so you don't go nuts buying seven different kinds. And, you may decide to use only one value of rheostat for R_1, one that will satisfy all tones. Fine, no problem. But if you run into trouble, these design notes will help you out.

It is customary to have a high when the desired tone is pushed. The NOR gate at the output works fine because when the PLL locks, the error voltage is zero and a low is present. Both PLL lows presented to the NOR gate will give a high output. ■

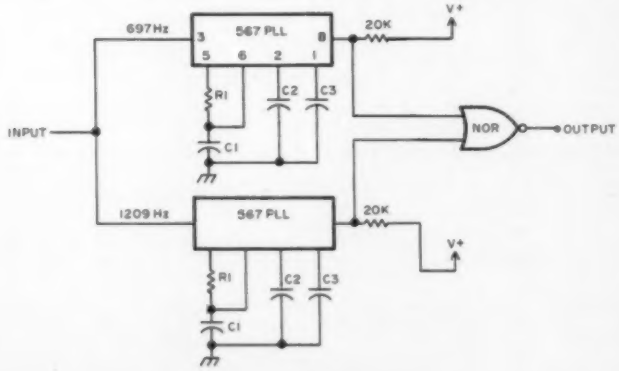

Fig. 9. Decoder.

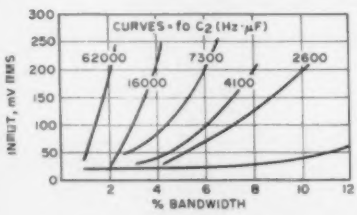

Fig. 10. Graph for determining C_2.

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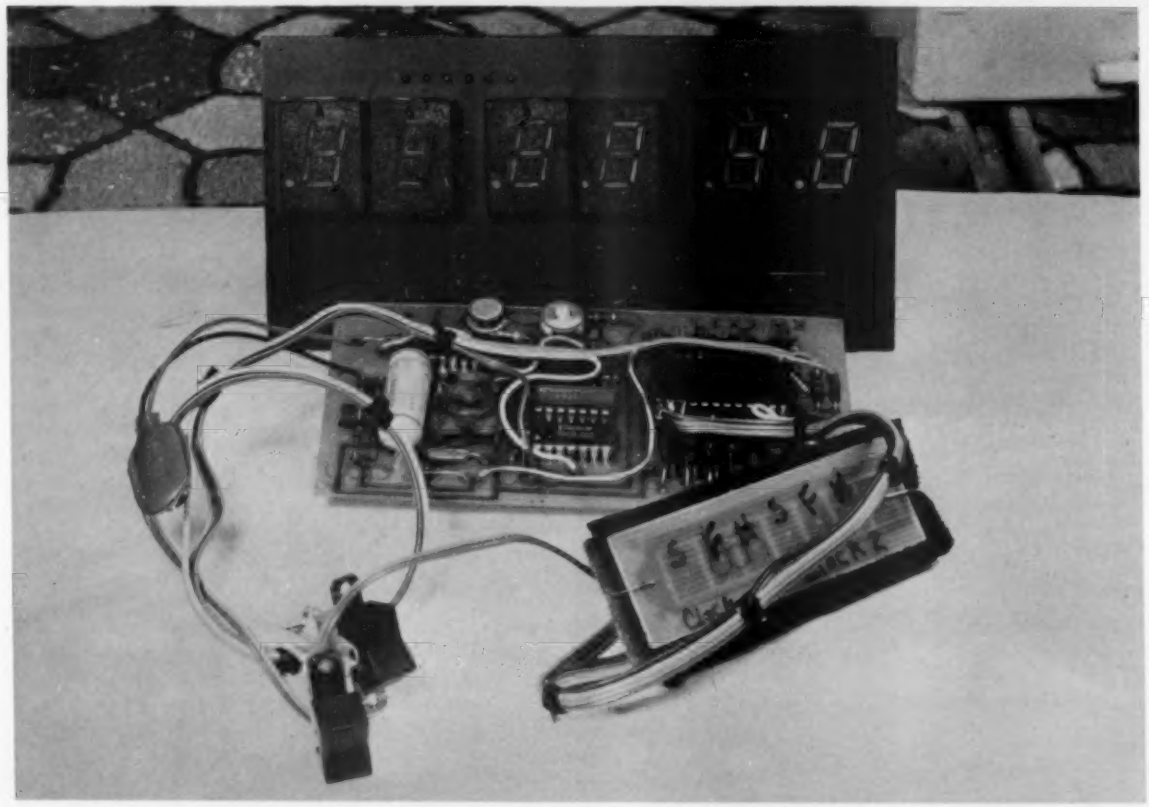
The Two-Timer

The two-time clock will display either of two different times and also flash the display at a one Hertz rate every ten minutes to remind you that it's time to ID. This clock can give you local time normally, and with a flick of the switch you have Greenwich Mean Time for operation and logging. The clock was designed with several things in mind: reliable continuous operation, two separate time display capabilities, a station ID reminder, and the ability to use several different power sources. A further qualifica-



tion was that all parts be readily available to the hobbyist/amateur from usual sources. The final design was able to fulfill all the qualifications.

Theory of Operation – Clock

The simplest way to understand this circuit is to treat it as if it were a single 5314 clock with the interfacing to drive common cathode LED displays. Complete details on this circuit can be found in the National Semiconductor MOS Integrated Circuits Book in the section covering the MM5314. The 60 Hz for time keeping and the 960 Hz for the multiplex frequency are obtained from the oscillator divider circuits.

All inputs and outputs for both ICs are in parallel except the output enables (pin 1), the time setting pins (pins 13, 14 and 15) and if desired the 12/24 hour select pin (pin 10). The output enable lines are used to enable the segment outputs from the desired chip. The resistors R_{12} and R_{13} act as pull downs, holding the not selected chip's output enable low and placing that chip's segment output in a non-conducting high impedance state. The output enable of the chip selected by S_2 is either held high or pulsed high by the output of the ID timer. The multiplex timing signals for both ICs come from the same source, allowing the digit enables to function in unison.

Theory of Operation – Oscillator-Divider

The oscillator makes use of two inverters in the CD4060 to form a series resonant crystal oscillator. The 1M Ohm resistor limits the crystal drive voltage and the 4.75 Ohm resistor provides the feedback. The capacitor, C3, gives the circuit phase lead allowing the crystal to operate at series resonance. The output of this oscillator is 15.36 kHz, which is then fed into a 14 stage binary divider. The base frequency of 15.36 kHz is divided by 2^5 for 960 Hz, 2^8 for 60 Hz and 2^{12} for the 3.75 Hz used in the ID timer. Grounding pin 12 allows the oscillator and counter to function continuously. Pin 12 is the reset for the counter and shuts the oscillator off when it is pulled high.

Station ID Timer

The 3.75 Hz square wave from the OSC divider is fed into the input of a CD4040 twelve stage binary divider. The outputs of the 2^7, 2^8, 2^6, and 2^{12} stages are fed into one half of a CD4012 which acts as a coincidence detector. When 2160 pulses have been fed into the CD4040 there will be 1s on the 2^5, 2^6, 2^7, and 2^{12} outputs and zeros at all other outputs. When this happens the output of the first half of the CD4012 will go low, which is then inverted by the second half of the CD4012. A high level on the output of the second half of the CD4012 sets the RS flip flop made up of two of the four gates in a CD4001. The $\overline{Q}$ output of the RS flip flop is now forced low and NORed with the output of the second stage of the CD4040, a .937 Hz square wave. When both

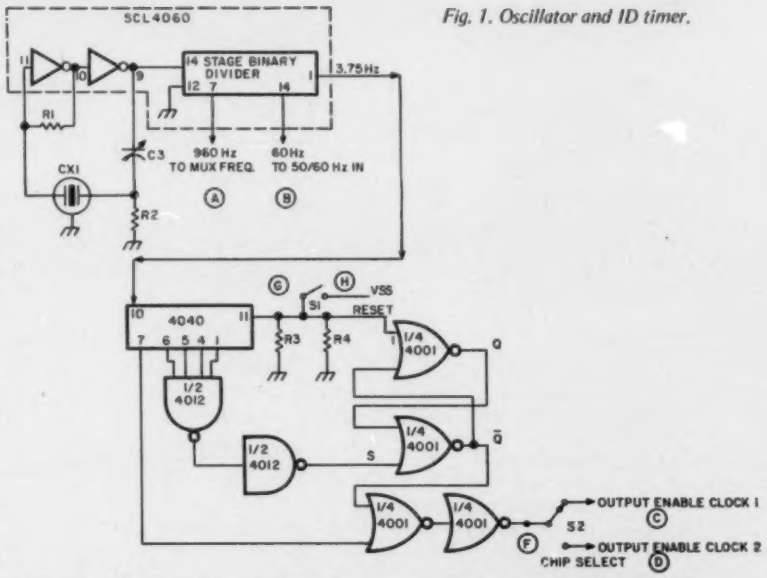
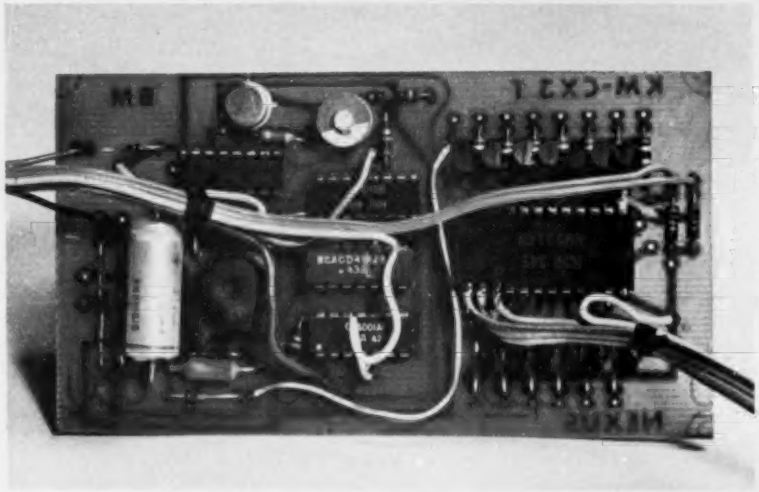


Fig. 1. Oscillator and ID timer.



Clock board.

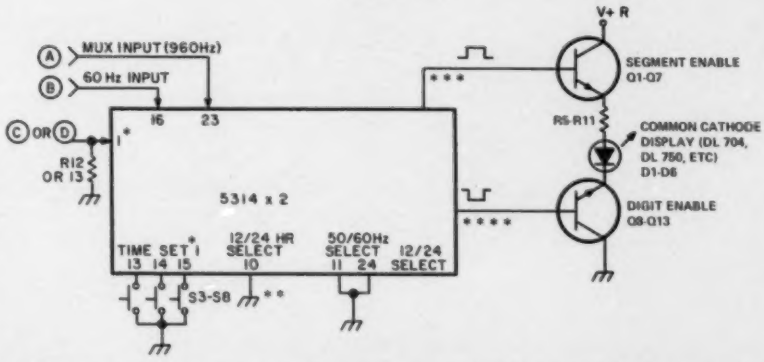


*Fig. 2. Clock chip connections. *These connections are made to each chip separately – all other pins are in parallel. **See text for connection. ***Segment outputs: Pin 3/Segment A, 4/B, 5/C, 6/D, 7/E, 8/F, 9/G. ****Digit outputs: Pin 19/Digit H10, 20/H1, 21/M10, 22/M1, 17/S10, 18/S1.*

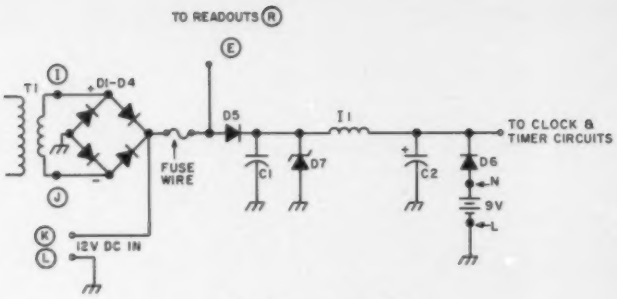


Fig. 3. Power supply.

inputs are low, the output goes high and is then inverted by the remaining quarter of the CD4001, which drives the output enable of the selected clock chip. The result is a .937 Hz blinking in the clock display. Switch S_1 is closed to place a high on the reset input of the RS flip flop and the binary divider, which reset both of them. With the RS flip flop reset, the Q output is high, forcing the output of the NOR gate low, which is inverted and holds the selected clock chip output enable high until the cycle is repeated. Placing S_1 in the reset position inhibits the operation of the ID timer. The output of either NOR gate may also be used to trigger an audible circuit of some type.

Power Supply and Filtering

The power supply will take either 9-12 V ac or from 10-14 V dc for power. When neither is present the clock will continue to operate from the 9 V battery but the displays will not light. Diode D5 prevents the standby battery and filter cap C2 from being drained by the readouts. Capacitors C1 and C2, inductor 1, and zener diode D_7 form a filter network for the ac supply and also act as spike and over voltage protection circuit for operation from a 12 V automotive system. Diode D5 also prevents damage in case the power is connected in reverse.

Construction is relatively straightforward using the printed circuit layouts. The use of two boards allows the clock to be assembled in a minimum of space and with only two jumpers on the clock board. The 17 interconnections between the clock and readout boards also serve as bracing.

The two 5314 clock chips are soldered together pin to pin with the exception of pins 1, 13, 14 and 15. If 12 hour operation is desired on only one chip, then it must be the bottom one. Pin 10 on the top chip is left unattached for 24 hour operation. For either dual 12 or 24 operation, pins 10 on both chips are soldered together. The trace to pin 10 is cut for dual 24 hour operation and left connected for dual 12 hour operation.

Switch S_2 is a single pole double throw, while S_1 is a single pole single throw switch, as are the time setting switches. Power from the ac line comes from a wall plug transformer.

There are only two critical procedures in putting this clock into operation: adjusting the oscillator for 60 Hz and syncing the digit enables of the two clock chips.

The oscillator can be adjusted by any of several methods: The 60 Hz can be beat against the line frequency, a scope set to line triggering can be used, and the frequency adjusted until a stable wave form is obtained, or a frequency counter can be used. If none of the above is available the clock can be run against a known standard and adjusted until it matches.

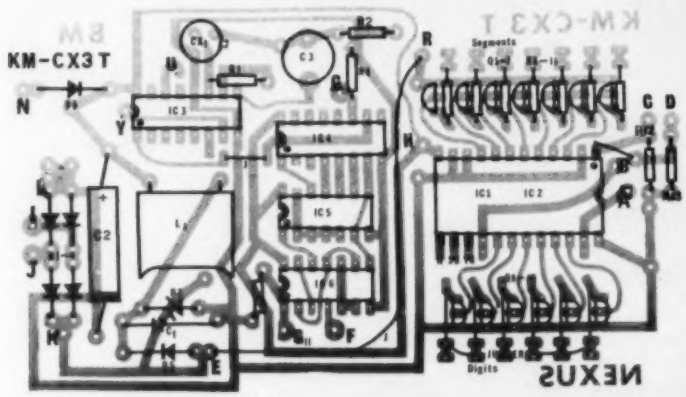


Fig. 4. Clock board (full size).

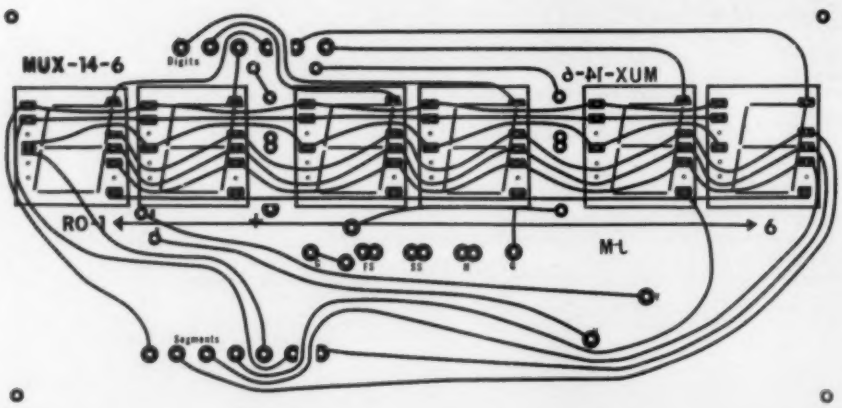


Fig. 5. Readout board (full size).

To synchronize the digit enable lines it is necessary to disconnect all power from the clock including the standby 9 V battery and ground the positive side of C2. The ground on the positive side of C2 is removed and the standby battery is now reconnected, then normal power is applied to the clock. If the display is not correct on both clocks, check the 9 V battery's voltage and replace it if it is not above 8.2 V. Repeat the above procedure again.

At this point the only thing left to check is the 10 minute timer. The actual time is related to the timebase and should be 9.6 minutes. Place the reset switch in the reset position and then back to the timer position. Approximately 10 minutes later the display should start blinking and continue to do so until it is reset. The timer can be disabled by leaving the reset switch in the reset position.

This clock, with its unusual features, should provide you with a timepiece usable in many situations and not subject to the annoying time glitches of its line-based brothers. ■

Parts List

You can beg, borrow, steal, scrounge, or otherwise purloin the following parts. Or save time, trouble, and anxiety pains by purchasing the whole kit and kaboodle from Nexus Trading.

C_1	.1 uF disc cap
C_2	250 uF/25 V electrolytic cap
C_3	3-12 pF ceramic trim cap
CX_1	15.36 kHz crystal
D_1-D_6	1N914 or F125
D_7	15 V/400 mW zener – 1N965B
I_1	680 uH inductor
$IC_{1,2}$	MM5314
IC_3	CD4060
IC_4	CD4040
IC_5	CD4012
IC_6	CD4001
Q_1-Q_7	2N3904
Q_8-Q_{13}	2N3906
R_1	4.7M Ohm ¼ Watt
R_2	1 M Ohm ¼ Watt
$R_{3,4}$	10k Ohm ¼ Watt
R_5-R_{11}	24 Ohm ¼ Watt
R_{12}-R_{13}	2k Ohm ¼ Watt
RO_1-RO_6	DL750 (common cathode)
S_1	SPST switch
S_2	SPDT switch
S_3-S_8	SPST push-button switch

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by
Robert E. Bloom W6YUY
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How Accurate Is Your Counter — Really?

But I can't be off frequency by two kHz. I just calibrated my transceiver with my counter which was just set with WWV! This is a comment most often heard among hams operating 2 meter repeater FM. The resulting dialogue indicates there is much misunderstanding among the ranks as to counter frequency accuracy, how a counter should be calibrated and the relationship with one's transmitter output frequency. This article's intention is to shed light upon the multiple ramifications involved in frequency counter calibration.

A most likely starting point, therefore, is the counter time base oscillator. This usually is comprised of a 100 kHz, 1.0 MHz, 5.0 MHz or 10.0 MHz crystal oscillator which may or may not be temperature stabilized with an oven. Typical time base accuracy may be as good as one part in 10,000,000 ($1/10^7$) or less per 24-hour period. If measurements with reasonable repeatable accuracy are expected, the counter will require a minimum warm-up time of one hour with 24 hours' time being recommended. If the counter is being calibrated to factory specifications, a 24-hour period becomes minimum and 3 months is not unheard of.

A laboratory-type crystal reference oscillator used to calibrate the basic time base oscillator in a counter generally goes not reach its stabilized aging rate until a minimum "ON time" of 3 months. This type of standard has its complete oscillator circuit encased in a heavily constructed double oven (an oven within an oven). The typical size of such an oven may be as small as 8" long and 3" in diameter and ovens twice this size are quite common. Such oscillators, when calibrated against WWVB or WWVL, 60 kHz and 20 kHz, respectively, have accuracies as great as one part in one hundred billion ($1/10^{11}$), with $1/10^{10}$ being typical in a metrology laboratory.

A comment quite often heard by lab technicians and radio amateurs contains the following substance: "I have the audible capability to zero beat a signal emanating from the speaker of my receiver." If this is so, then these individuals have indeed been endowed with a very special human ability . . .

The transmitted accuracy of the N.B.S. (National Bureau of Standards) WWV transmission from Boulder, Colorado is $1/10^{10}$, one part in ten billion. Because of signal path distortions, however, the accuracy is degraded by about two orders of magnitude or possibly more. This is known as "The Doppler Shift." The received accuracy is now $1/10^8$ or less. Under the most optimum of receiving conditions and using the best calibration techniques, including an overall time period of 6 weeks for the daily corrections of the crystal oscillator frequency, one could achieve a counter time base accuracy of one part in 10^7 or .00001%.

Reference laboratories on the other hand do not use the WWV transmission

frequencies of 2.5, 5.0, 10.0 or 15.0 MHz because of the limited accuracies available. The low frequency transmissions of WWVB and WWVL are used as they are not subject to the same types of transmission frequency distortions. In addition they can be and are transmitted with much higher accuracies. The transmitter oscillators of WWVB and WWVL do not use crystals. They are controlled by atomic references.

The Cesium Beam standard is an atomic resonant device which provides access to one of Earth's invariant frequencies in accord with the principles of quantum mechanics. It is a true primary reference and requires no other reference for calibration. A cesium atomic beam resonator controlled oscillator is used and is the nation's primary frequency reference. The accuracy of transmission is $1/10^{13}$, one part in ten trillion.

Time and frequency are intangible quantities which can be measured only with respect to some physical quantity. The basic unit of time, the second, is defined as the duration of 9,192,631,770 periods of transition within the cesium atom.

The transmissions of WWVB on 60 kHz are intercepted on receiving equipment of very narrow bandwidth, usually a few Hz wide. The time interval between a local reference oscillator and the frequency of WWVB are compared minute by minute on a strip chart recorder which records the phase differences. The resolution of this comparison is typically 1 us. One part in 10^{10} takes 10^4 sec. to achieve a 1 usec. error (somewhat less than 3 hours).

The transmission of WWVB is coded in the binary coded decimal system. The characters are formed by variations of the carrier in ± 10 dB levels. This presents time-of-year information each minute: the minute, hour, day of the year and the millisecond difference between the broadcast signal and UT2 time.

Universal time, defined as UT time, is the time of day on earth. UT time varies with the variations of the earth's rotation. UT2 time is one of a number of offset times used to correct for seasonal variations in the earth's rotation. These variations are caused by displacement of matter in and over the earth's surface.

Other devices of interest as frequency standards are the Thallium beam, the Ammonia maser, the Hydrogen maser and the Rubidium gas maser. The Rubidium vapor reference standard uses a passive resonator to stabilize a quartz oscillator. It is considered a secondary standard because it must be initially calibrated against a primary standard such as a Cesium Beam. Once adjusted and sealed, the frequency remains superfinely stable and the frequency accuracy is within parts in 12^{12}.

The crystal oscillator, although not the most stable, is still the most economically available to the ham. It is also compact in size and fits easily into the geometry of a compact frequency counter. The frequency counter does have a number of inaccuracies and the crystal reference frequency oscillator is the major one.

The crystal is the time reference base for a divider chain which basically sets up start and stop trigger pulses in the counter. The counter has a number of these, 1 Hz, 10 Hz and 1 kHz being typical. Besides the time base inaccuracy there is also an inherent trigger error which causes a ± 1 count in the readout. The crystal when first turned on has a large drift error. This is overcome by use of an oven and a warm-up period. Thereafter the crystal has an aging rate. This is a constant periodic upward change in frequency with time. All crystals have it. After about 90 days of ON time this rate becomes quite predictable and can be compensated for if the oscillator is equipped with a dial capable of a 1,000 to 1 or better resolution. On the finer laboratory oscillators this vernier readout can be related to time in microseconds.

One does not expect the average ham either to possess the accurate equipment usually found in a metrology laboratory or to apply the techniques necessary for such accuracy. The awareness that such equipment does exist, however, sheds light upon what is required to make accurate calibrations . . .

The average ham is most apt to set up the counter's reference oscillator by zero beating the counter's time base reference oscillator against WWV's high frequency transmissions. This is generally performed aurally after a warm-up period of 1-5 hours. Most often, the inexperienced ham may wind up by beating against the audio of the transmitted signal in which case the crystal will be set to the wrong frequency. WWV usually uses 440 Hz for a period during the hour, then shifts to 600 Hz. If the oscillator has been zero beat to one of these, the error will become apparent when the modulation frequency is changed as the apparent zero beat will have disappeared.

A comment quite often heard by lab technicians and radio amateurs contains the following substance: "I have the audible capability to zero beat a signal emanating from the speaker of my receiver." If this is so, then these individuals have indeed been endowed with a very special human ability, especially when one considers that the human ear cannot hear frequencies below 30 Hz regardless of their amplitude. This also brings into view the necessary unusual hi-fi characteristics required of the receiver's output transformer which probably does not respond below 100 Hz – to say nothing of the speaker response. What one actually is hearing is a difference in the amplitude in the noise frequencies accompanying the signal.

One does not expect the average ham either to possess the accurate equipment usually found in a metrology laboratory or to apply the techniques necessary for such accuracy. The awareness that such equipment does exist, however, sheds light upon what is required to make accurate calibrations. It, therefore, follows that if it is not practical for the amateur to make time interval measurements on the time base generator of a counter and the follow-up corrections in time and frequency, then it also is not reasonable that the amateur expect to have time base frequency accuracy to within $1/10^7$. A more reasonable accuracy level can be expected by following certain ground rules. Allow a 5 hour minimum warm-up time if the equipment uses an oven, 1 hour if not; the time base generator (crystal) should be calibrated by use of a null detector against one of WWV's higher frequency signals, and the intended measurements with the counter be executed as soon

thereafter as practicable. Expected accuracy will be in parts per million or slightly better of the WWV referenced frequency.

A recommended procedure that affords quite good zero beat capability and is readily available to most radio amateurs is as follows:

1. Tune in the WWV frequency to be used. The reception of the signal should be free of fading.

2. The oscillator signal to be calibrated should be coupled so that its amplitude closely equals that of the incoming WWV carrier level.

3. Zero beat aurally as closely as possible, then continue refining the adjustment while observing the receiver "S" meter indication. As zero beat is achieved the "S" meter will reach either a maximum or minimum stabilized indication. This reading will be maximum if both signals are of the same phase relationship or minimum if the phase is out by 180 degrees. It is of little concern which is obtained just so the meter needle has stabilized its position.

If the crystal is of high stability quality and is in an oven, one might want further refinement in the long-term stability capability. In such case it will be required that the crystal oscillator be left on continuously. Further refinements in the zero beat setting will be required each 24 hours, first to correct for the initial phase error setting and then to correct for the crystal aging rate. These further refinements could result in parts in 10^7 accuracy.

Note: For long-term stability a 1.0 MHz or higher crystal is recommended. Zero beat becomes more difficult the higher the WWV referenced frequency. This follows because the resolution of adjustment is reduced and you are working to a finer tolerance.

Assume that the received signal is accurate to 1 part in a million ($\pm 10^{-6}$) and that the adjustment you have just made was set to zero beat with $\pm 10^{-6}$ of the received signal. This will produce a short-term accuracy of $\pm 2/10^6$ Hz. Therefore one can set a 147.00 MHz transceiver frequency to an accuracy of ± 294 Hz depending on which side of the WWV carrier frequency you are zeroed in on. This accuracy will decay with time elapse between the act of calibration and use of the counter.

The above happens to be the hard core truth and should start spinning the mental wheels of those who wonder why they are 2.0 kHz off the center of the repeater bandpass.

For the ham fortunate enough to have the means to perform more accurate measurements, the following is supplied.

1. Counter minimum ON time: 90 days.

2. Compute oscillator drift rate for single measurement spans. The average fractional error of frequency is equal to the fractional time error which is given by:

$$\frac{\Delta f}{f} = \frac{t_2 - t_1}{T}$$

Where

$\frac{\Delta f}{f}$ = Average frequency error.

t_1 = Initial time comparison reading.

t_2 = Final time comparison reading.

T = Elapsed time between readings.

Example (Time comparison reading at 9 am May 1 = 4.64 ms. A reading on 9 am May 4 = 1.70 ms.):

$$\frac{\Delta f}{f} = \frac{4.64\text{ ms} - 1.70\text{ ms}}{3\text{ days}} \times \frac{1\text{ day}}{8.64 \times 10^7} = \frac{2.94}{3 \times 9/74 \times 10^7}$$

$$= \frac{29.4}{25.92 \times 10^6} = \frac{1.19}{10^6} \text{ or } 1.19/10^6$$

That is, the average oscillator error during this period (or assuming a constant frequency drift, the instantaneous error at 9:00 am on May 2) is 1.19 parts per million high. The average frequency of the oscillator during this measurement interval is given by:

$$f_{av} = f_{nom.}\left(1 + \frac{\Delta f}{f}\right)$$

Where

f_{av} = Average frequency.

$f_{nom.}$ = Normal Oscillator frequency.

$\frac{\Delta f}{f}$ = Average frequency error.

Thus, continuing with the above example and an oscillator with a nominal frequency of 1.0 MHz,

$$f_{av} = 10^6\left(1 + \frac{1.19}{10^6}\right) =$$

1,000,000.119 Hz

Using this method of continuous corrections and recording continuous data one is able to iron out the propagation anomalies of WWV and approach a precision better than 1 part in 10^8. Now with this background behind you – do I hear someone questioning the accuracy of the local repeater frequency??? ■

LETTERS

ou goons don't ever proofr
l
bu
you ignored my comments in
I insist that you print ev

from page 14

to the 13+ tape, and I found out that the hard way isn't so hard after all. I simply sat down with the faster tape and copied as much of it as I could. At first this wasn't much, and I got very frustrated, but as time went on, I found I was copying several code groups in a row ... then a solid minute ... and finally copying it almost solid.

I would like to take this opportunity to publicly thank Jim WB2EDW, who provided an enormous amount of help for me in getting the theory together for the Advanced test. There really are hams around who are willing to help other people with code and theory, and Jim is one of them. (He and his wife, Kathy, also gave me a very good Thanksgiving dinner!) I'd also like to thank Dave WA2CLS for his help.

Finally, I'd like to ask for some help. In 1958 Jim Lev K6DGX administered the Technician test to me (after having shepherded me through the Novice license). I've tried to write to him, but apparently he is no longer at his callbook QTH. Will you please print my address with this, so that if Jim reads it he can contact me, or if anyone else who knows Jim reads it they can either tell him about it or write to me with Jim's QTH? Thanks.

Paul Busby ex-K5QJL, K9ZEM
Box 613
Grand Central Station
New York NY 10017

KH-1B

I am looking for a schematic for a KH-1B keyer or information on how to hook it to a Viking Valiant.

Joe Robidoux WN1UDU
829 Lebanon Hill
Southbridge MA 01550

SOCIAL EVENTS

TOWSON MD
APR 4

The Greater Baltimore Hamboree will be held April 4, 1976 at 8 am at the Calvert Hall College, Goucher Blvd. and LaSalle Road, Towson MD 21204. (One mile south of exit 28, Beltway-Interstate 695). Food service, prizes, contests and a giant flea market. 250 tables inside gym. Registration $2. Over 1000 attended last year. Information: Contact Brother Gerald Malseed at school address or call 301-825-4266.

DAYTON OH
APRIL 23

The 7th Annual F.M. BASH will be held on the Friday night of Dayton Hamvention April 23, 1976 at the Dayton Biltmore Towers (hotel) in the downtown area. This new location will accommodate the ever-increasing crowd and will allow a leisurely social evening and a live floor show, featuring television personality Rob Reider (WA8GFF) and his group. Admission is free to all hams and their ladies, and includes free snacks and a C.O.D. bar. A fabulous prize drawing at 11 pm includes a Clegg FM-DX transceiver. Hours are from 9 pm til midnight. Miami Valley F.M. Ass'n., Milt Kohl W8SLY.

GRAND RAPIDS MI
APRIL 24

The 2nd Annual Swap and Shop will be held Saturday, April 24, 1976, 9 am to 5 pm in the auditorium at Woodland Mall on East 28th Street in Grand Rapids, Michigan (corner of M11 and M44). Featured will be ham equipment, electronic parts, monitors and CB. Admission $1.50. For further information write: Grand Rapids REACT Inc., PO Box 2402, Grand Rapids, Michigan 49501.

SULLIVAN IL
APRIL 25

The Moultrie Amateur Radio Klub announces its 15th Annual Hamfest at the American Legion Pavilion in Wyman Park, Sullivan, Illinois on the 25th of April, 1976. Rain or shine, same place as always.

AMBOY IL
APRIL 25

The Rock River Hamfest will be held April 25, 1976, Amboy, Illinois Lee Co. 4-H Center Jct. 30 & 52. Same place as last year. $1 advance, gate $2, write Carl Karlson W9ECF, PO Box 99, Nachusa, Illinois 61057. Rain or shine — indoor or out, camping, large swap shop, food, and many prizes. Short trip west of Chicago. Talk-in 146.94.

CADILLAC MI
MAY 1

The Wexaukee Amateur Radio Association announces their 16th Annual Swap-Shop and Eyeball that will be held May 1st in the National Guard Armory in Cadillac, Michigan, starting at 9 am. This Swap-Shop is open to all radio amateurs, citizens banders, and anyone interested in radio communications. Lunches will be available at noon and there is lots of free parking. Tickets available at the door.

Oscar Orbits

Oscar 6 Orbital Information					Oscar 7 Orbital Information			
Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W	Mode	Orbit	Date (Apr)	Time (GMT)	Longitude of Eq. Crossing °W
15820	1	0043:08	65.4	B	6293	1	0008:55	52.0
15833	2	0138:04	79.1	A	6306	2	0103:12	65.6
15845	3	0038:00	64.1	B	6318	3	0002:32	50.4
15858	4	0132:56	77.8	A	6331	4	0056:49	64.0
15870	5	0032:52	62.8	B	6344	5	0151:06	77.6
15883	6	0127:47	76.6	A	6356	6	0050:26	62.4
15895	7	0027:43	61.6	BX	6369	7	0144:43	76.0
15908	8	0122:39	75.3	A	6381	8	0044:04	60.8
15920	9	0022:35	60.3	B	6394	9	0138:21	74.4
15933	10	0117:31	74.1	A	6406	10	0037:41	59.2
15945	11	0017:27	59.1	B	6419	11	0131:58	72.8
15958	12	0112:22	72.8	A	6431	12	0031:18	57.6
15970	13	0012:18	57.8	B	6444	13	0125:35	71.2
15983	14	0107:14	71.6	AX	6456	14	0024:55	56.0
15995	15	0007:10	56.6	B	6469	15	0119:12	69.6
16008	16	0102:06	70.3	A	6481	16	0018:33	54.4
16020	17	0002:02	55.3	B	6494	17	0112:50	68.0
16033	18	0056:57	69.1	A	6506	18	0012:10	52.8
16046	19	0151:53	82.8	B	6519	19	0106:27	66.4
16058	20	0051:49	67.8	A	6531	20	0005:47	51.2
16071	21	0146:45	81.6	BX	6544	21	0100:04	64.8
16083	22	0046:41	66.5	A	6557	22	0154:21	78.4
16096	23	0141:37	80.3	B	6569	23	0053:41	63.2
16108	24	0041:33	65.3	A	6582	24	0147:58	76.8
16121	25	0136:28	79.0	B	6594	25	0047:19	61.6
16133	26	0036:24	64.0	A	6607	26	0141:36	75.2
16146	27	0131:20	77.8	B	6619	27	0040:56	60.0
16158	28	0031:16	62.8	AX	6632	28	0135:13	73.6
16171	29	0126:12	76.5	B	6644	29	0034:33	58.4
16183	30	0026:08	61.5	A	6657	30	0128:50	72.0

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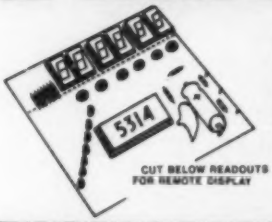
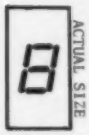
SON of a CHEAP CLOCK & time base kit ⇨⇨⇨⇨ $23.50!





A lot of you are already familiar with the "Son of a Cheap Clock" and what it has to offer --- like the .3" digits, choice of 12/24 hr and 50/60 Hz operation, segment and driver transistors for brighter digits, sockets for IC and all readouts, and so on. Also, a lot of you have bought our time base kits that provide a source of 60 Hz timing pulses, thus freeing your clock from the AC line. Now, we offer them together at a special price. The clock is the same as our regular clock kit, but it of course doesn't come with a transformer. The time base is extremely accurate, stable, and a miser with power consumption. Our data shows you how to hook them together in your vehicle, as well as how to remote the readouts (so you can have your readouts on the front panel and stuff the electronics behind your dash), how to blank the digits for minimum standby current drain, and more.

HARD TO FIND CAPACITORS FOR TUBE FANS

AMERICAN MADE---TWIST LOCK TYPE---
85ºC rating. Top quality.

150 uf @ 350V.....75¢ ea, 2/$1.35
150 uf @ 350V and
200 uf @ 175V.....95¢ ea, 2/$1.75
200 uf @ 175V.....75¢ ea, 2/$1.35
10 uf @ 400V, 4 uf @ 350V, and 100 uf @ 350V.....65¢ ea, 2/$1.20

12 VOLT 8 AMP power supply kit

This supply is ideal for powering mobile rigs and other automotive equipment due to its high current capacity...yet it has enough precision and stability, as well as protection, to make a dandy lab or test bench supply. It offers better than .05 volt regulation, current limiting at 13 amps, adjustable output 11 - 14 volts, 12A output for intermittent (50% duty cycle) use, RF bypassing, and full short circuit protection. Kit does not include chassis or hardware. $22.50 and postage for 7 lbs.

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"ELECTRONIC PROJECTS FOR MUSICIANS is a new book, written by my friend Craig Anderton, which I heartily endorse for all electronic and musical types. The first four chapters tell how to identify and obtain parts, select and care for tools, and apply basic construction techniques; in short, an introduction to basic electronics a là Radio Amateur's Handbook. Chapter 5 contains 19 projects for musical/audio applications, and the book concludes with sections on troubleshooting and where to find more information.

---Bill Godbout, BILL GODBOUT ELECTRONICS

"In the first part of the book, Craig gives the basics...and a lot of very practical information on building projects. This information will be useful to the beginner whether or not he intends to build from Craig's book...or from just about anything else. This sort of writing is very difficult, and Craig has done it very well and with a feeling that leaves the reader with an impression of personal attention."

---B. A. Hutchins, ELECTRONOTES magazine

OK, HAMS, JUDGING FROM OUR ORDERS MUSICIANS AREN'T THE ONLY ONES BUYING THIS BOOK...MANY BEGINNERS IN ELECTRONICS CONSIDER THE FIRST 4 CHAPTERS ALONE WORTH THE PRICE OF ADMISSION. THIS MONTH, WE ARE GIVING YOU A LITTLE MORE INCENTIVE TO GET A BOOK NOW: WE'VE GOT A LIMITED QUANTITY AUTOGRAPHED BY THE AUTHOR, AVAILABLE ON A FIRST COME - FIRST SERVED BASIS. ENJOY!!

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20.480	24.576	28.160	30.720	32.768	36.854	38.400	40.960
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CONTESTS

from page 32

BARC CONTEST

Phone: Starts: 0001 GMT, Saturday, April 24; Ends: 0200 GMT; Sunday, April 25; CW: Starts: 0001 GMT, Saturday, May 8; Ends: 0200 GMT, Sunday, May 9

Any number of transmitters/receivers will be allowed. However, all stations participating must be single operator only. All contestants must operate from their own private residence or property. North America and United Kingdom winners are ineligible for a period of two years, regardless of section won. Use all amateur bands from 80 to 10 meters. No crossband or crossmode contacts will be permitted.

US and Canadian stations may contact UK and VP9 stations only. UK stations may contact US, Canadian, and Bermuda stations only. UK stations are requested to use the official RSGB counties list and abbreviations to avoid confusion.

EXCHANGE:

RS(T) and state, province, UK county or Bermuda parish.

SCORING:

Each completed contact counts 3 points. The multiplier for all stations outside Bermuda is the total number of different VP9 callsigns worked on each band. For Bermuda stations the multiplier is the total number of states, provinces, and UK counties worked on each band. The final score is the sum of all QSO points times the total multiplier.

LOGS:

All dates and times must be in GMT and all contestants must compute their own scores and check logs for duplicate contacts. Include a signed statement that all contest rules and license terms have been complied with. Please print your name, call and address on each page of your log. All logs must be received by the Contest Committee, Radio Society of Bermuda, PO Box 275, Hamilton 5, Bermuda — not later than June 30, 1976.

AWARDS:

A trophy will be awarded to the phone and CW winners in North America and United Kingdom. Round trip air transportation plus one week's accommodation at the Sonesta Beach Hotel will be provided to overseas winners to enable them to receive their awards at the Radio Society of Bermuda's Annual Banquet to be held on October 21, 1976.

HELVETIA 22 CONTEST

Starts: 1500 GMT, Saturday, May 1; Ends: 1700 GMT, Sunday, May 2

Use all bands, 160 to 10 meters, CW to CW or phone to phone; no crossmode contacts.

EXCHANGE:

RS(T) and 3 figure serial number from 001. Swiss stations will also send the abbreviation of their canton. Abbreviations of the 22 cantons are: AG, AR, BE, BS, FR, GE, GL, GR, LU, NE, NW, SG, SH, SO, SZ, TG, TI, UR, VD, VS, ZG, ZH.

SCORING:

Each contact with a HB station counts 3 points. Each station can be worked once per band, either on CW or phone. The multiplier is the sum of Swiss cantons worked on each band, making a possible multiplier of 22 per band. Your final score will be the sum of QSO points multiplied by the sum of cantons worked on each band.

AWARDS:

Certificates will be given to the highest scorer in each country. USA and Canadian call areas are considered as separate countries.

LOGS:

Logs must be postmarked not later than 30 days after the contest and sent to: TM USKA, Rene Oehninger HB9AHA, 5707 Seengen/AG, Switzerland. Send QSLs for each of the 22 cantons worked on CW or phone for the Helvetia 22 Award to: Blattner Walter HB9ALF, President USKA, via B. Varenna 85, 6604 Locarno, Switzerland.

MASSACHUSETTS BICENTENNIAL QSO PARTY

Starts: 0000 GMT, Saturday, May 1; Ends: 2400 GMT, Sunday, May 2

The contest is sponsored by the South Shore Repeater Association, WR1ACT, of Scituate MA and is endorsed by the Mass. Bicentennial Commission. Any station may be worked once per band; CW and phone are considered separate bands. No crossband or repeater contacts are permitted. MA stations may work other MA stations.

FREQUENCIES.

Phone: 1820, 3960, 7260, 14290, 21390, 28590, 50.110, 146.52. CW: 1810, 3560, 7060, 14060, 21060, 28060. Novice: 3720, 7120, 21120, 28120.

EXCHANGE:

RS(T) and county for MA or ARRL section/country for others.

SCORING:

Each completed QSO counts 2 points. Outside stations multiply total QSO points by total number of different MA counties (max 14) worked. MA stations multiply total QSO points by the number of MA counties plus ARRL sections (not EMASS or WMASS) and DXCC countries worked.

AWARDS:

Distinctive awards will be given along with a certificate for working all MA counties. Separate awards will be given for VHF bands.

ENTRIES:

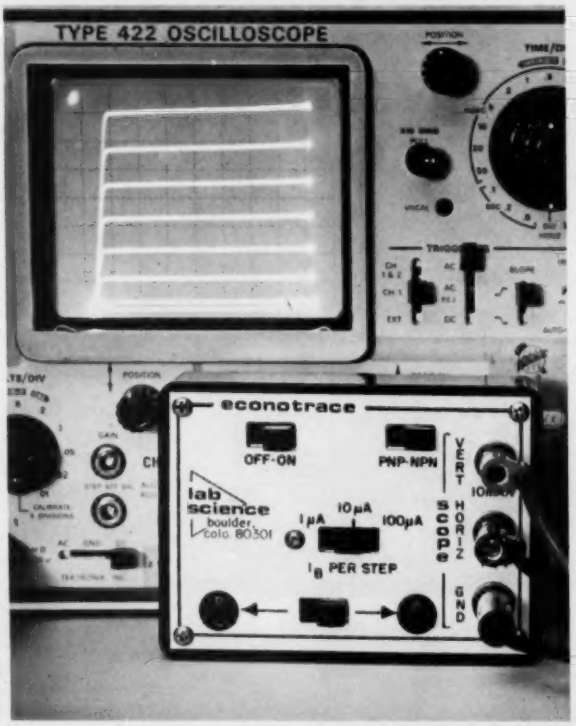
Mailing deadline is July 15, 1976 and should be sent to: R. J. Doherty W1GDB, RFD #1, 14 Pine Street, Sandwich MA 02563. Include an SASE for results and awards. Decisions of the contest committee are final and logs will become the property of WR1ACT.

NEW PRODUCTS

Lab Science's ECONOTRACE

If you're the kind of person who has to see something to believe it, this new product might be right down your alley. That is, if you test many transistors (and what ham doesn't?). Imagine going through that box of "unknowns" on your bench, and finding out all about them, in just a few minutes. Just plug the device into the "ECONOTRACE," connect three leads to your oscilloscope, and you're ready. One catch: *You* provide the 'scope. Display leakage (ICBO), DC & AC beta, low voltage breakdown, almost anything the big expensive tracers display, according to the manufacturer, Lab Science, PO Box 1972, Boulder CO 80302.

The big advantage is price: the ECONOTRACE sells for $39.50 (plus $1.00 for postage & handling), about a third of the nearest competitor. And it comes completely assembled, ready to operate. One disadvantage: Since it's battery operated, it only tests up to ± 9 volts and ± 90 milliamperes, so it is no good for testing high voltage characteristics. What it is good for is making transistor testing simple and exact (all drives and outputs are calibrated). You can also compare or match devices, just like on the big tracers, with just a flick of a switch. It's also small, 2-7/8 x 4 x 1-7/8 inches, lightweight (10 oz.) and comes complete with its own battery, which lasts for a year. Furthermore, Lab Science offers it on a 30 day, no strings, money-back guarantee, so you too can see it to believe it.



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$9.50 ea.	$8.50 ea.	$6.95 ea.
QTY OF 1 to 5	QTY OF 6 or MORE	Qty of 6 or more when each kit is purchased with a transformer, PC board, and cabinet.

KIT INCLUDES:
- INSTRUCTIONS
- QUALITY COMPONENTS
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- 50 or 60 Hz OPERATION
- 12 or 24 HR OPERATION

6 LED Readouts (FND-70 .25 in. RED)
1 MM5314 Clock Chip (24 pin)
13 Transistors
3 Switches
3 Capacitors
5 Diodes
9 Resistors
24 Molex pins for IC socket

Printed Circuit Board for above (etched & drilled Fiberglass) $2.95
Standard Transformer 115VAC/8 VAC 1.50
Molded Cord Transformer 115 VAC/8 VAC 2.50
Plexiglas Cabinet II Red Chassis, White Case,
2¼"H x 4½"W x 5½"D (see below) 5.95

ORDER KIT #850 an incredible value!

6 Digit LED Clock-Calendar-Alarm Kit

• 12/24 HR TIME • JUMBO DIGITS (MAN-64) • 28-30-31 DAY CALENDAR • AC FAILURE/BATTERY BACK-UP • 24 HR ALARM – 10 MIN. SNOOZE • ALTERNATES TIME (8 SEC) AND DATE (2 SEC) OR DISPLAYS TIME ONLY AND DATE ON DEMAND • THIS KIT USES THE FANTASTIC CT-7001 CHIP. FOR THE PERSON THAT WANTS A SUPER CLOCK KIT (TOO MANY FEATURES TO LIST)!

50/60 Hz OP

COMPLETE KIT, including Power Supply, Line Cord, Drilled PC-Boards, etc.

39.95 ORDER KIT #7001B (CASE NOT INCLUDED)

Kit #7001-C same as #7001-B but has different LEDs. Uses 4 DL-747 .63" digits & 2 MAN-7 .3" digits for seconds. Complete kit, less case. **$42.95**

CABINET I

3" HIGH
6¼" WIDE
5½" DEEP

GREAT FOR CLOCK KITS.
White Plexiglas Case
Specify RED or GRAY Plexiglas Chassis

Chassis Serves As Bezel To Increase Contrast of Digital Displays. Use Gray With Any Color – Red With Red Displays Only (Red LED's with Red Chassis Brightest) **$6.95 ea.**

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(Ideal for Kit #850 above.)
All Plexiglas Red Chassis, White Case.
Red Chassis Serves As Bezel To Increase Contrast of LED Displays. **$5.95 ea.**

PLEXIGLAS FOR DIGITAL BEZELS

Gray or Red Filter
3" x 6" x 1/8" Approx. Size **75¢ ea. or 6/$3.50**

XTAL TIME BASE KIT for Clock-Calendar-Alarm Kit **$9.95**

(115 VAC or 12 VDC operation)
Uses 100.800 KHz xtal. For #7001 Kits only.

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MAN-64 AL	RED	.4"	$1.55 ea.	10/$15.00
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MAN-8	YELLOW	.3"	1.25	11.00
MAN-7	RED	.3"	.95	8.50
DL-707	RED	.3"	1.25	12.00
DL-747	RED	.63"	2.50	20.00
FND-510	RED	.5"	1.85	17.50
Common Cathode				
HP5082-7702	RED	.3"	$1.25 ea.	10/$11.50
FND-70	RED	.25"	.65	5.95
FND-503	RED	.5"	1.85	17.50
DL-750	RED	.63"	3.50	30.00
DL-704	RED	.3"	1.25	12.00
DL-33MMB	RED	3x.1"	.95	8.50

DIODES

1N4002	25/$1.95
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14 or 16 pin . . . 4/$1	25/$5.
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Sub-Miniature SPST ¼A. C&K #8631
N.O. 120VAC 50¢ 10/$4.

ROCKER SWITCH

SPDT 4/$1. 100/$20

4A 125 Vac/.5A 125 Vdc/1.5A 250 Vac

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MM5314	Clock only	3.95
CT-7001	CLK-CAL-ALM	7.95

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COMMON ANODE 14 PIN DIP

SUPER BRIGHT 7-SEG. LED

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Print Rate: 12.2 characters per second; 135 print positions; 16 inch carriage with 14 inch paper capacity; pica Gothic type style, upper and lower case. Horizontal: 10 characters per inch; Vertical: 3 or 6 lines per inch; manually set tabs. Keyboard: Standard keyboard layout, locked when off line or on line message printing. 91 characters, plus space tab, line feed and shift. Five additional keys on left for control functions – Transmit, Reset, Control Case, ETX, ETB. Two switch controls on right line control and power Off/On. Keyboard Printer can be used with mini-computors with 24 Volt supply and proper terminations, or it can be used stand-alone as an electric typewriter by mechanically unlocking the keyboard locking solenoid. Power Input: 115/120 VAC, 60 Hz., 60 Watts. Size: 21 x 17 x 9". Shipping Weight, 125 lbs. $225.00

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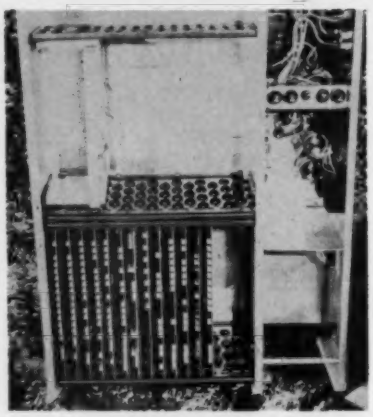

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Output Rates (Hz)			
X64	X16	X8	X1
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460.8 k	115.2 k	57.6 k	7200
307.2 k	76.8 k	38.4 k	4800
230.4 k	57.6 k	28.8 k	3600
153.6 k	38.4 k	19.2 k	2400
115.2 k	28.8 k	14.4 k	1800
76.8 k	19.2 k	9600	1200
38.4 k	9600	4800	600
19.2 k	4800	2400	300
12.8 k	3200	1600	200
9600	2400	1200	150
8613.2	2153.3	1076.6	134.5
7035.5	1758.8	879.4	109.9
4800	1200	600	75
921.6 k	921.6 k	921.6 k	921.6 k
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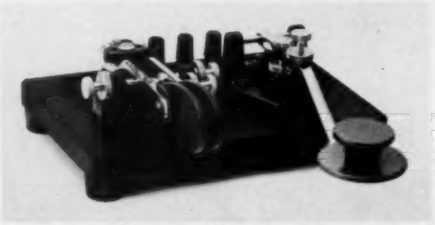

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Gray Matters

If any of you SSTV enthusiasts have ever been through setting up a monitor or even a camera, then I'm sure you can appreciate the need for a good accurate and stable tone source. Such a source was described as a construction article in the July 1975, *73 Magazine* on page 98. The item was by Dr. Robert Suding WØLMD, and was just too good to pass up. The ICs totalled up to $7.60 in a recent magazine ad, including the power supply regulator IC – typical of the low cost of TTL-ICs these days.

After I built this amazing little tone source that gives all the tones required for SSTV, and RTTY to boot, I was then tempted to make it even more useful to my needs in building my first monitor. I started building the monitor just for copying the weather satellites, but I have included all the normal SSTV parts in order to set it up and maybe even tune in on all the SSTV these days (on Oscar even!). The following is a small adapter to allow you to use the WØLMD tone source to produce an automatic gray scale for setting up your SSTV projects very accurately (see Fig. 1).

Circuit Changes

The adapter requires you to acquire 5 more ICs at first glance, which from a source like that used above (typical) runs a total of $2.03. Also, you will have to increase the current rating on the transformer used in the original article to 1 Amp. That is the only change to the original power supply. The only change to the rest of the original tone source is to change the control switch marked "Frequency Selector."

Dr. Suding was kind enough to do his frequency changing by only switching around a +5 V source, and therefore I was able to change to automatic switching very easily (see Fig. 2). If you will check the schematic of the adapter in the area of Q1, you will see this is only a simple "electronic switch" with discrete diode or gating. This replaces the original manual switching when the "gray scale pattern" mode of operation is chosen. The original switch called for a single pole (usually a single deck rotary) eleven position switch. Since these are usually twelve position switches anyway, the position 12 can be used for the new manual control switch by getting one with two decks. One deck switches ground around, and the other switches the +5 V, and the two levels control all switching while maintaining the original eleven discrete frequencies.

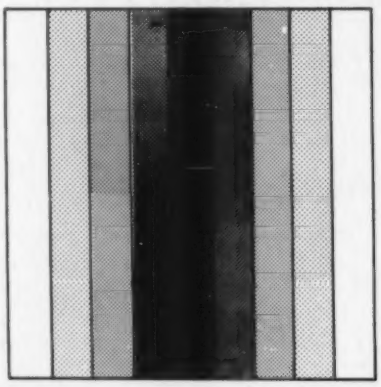

Fig. 1.

Fig. 3 is shown as a slide type switch only for clarity. Obviously, double pole or single pole individual switches could have been used for each position, but this allows the possibility of two on at once which can produce really weird results in this type of device. A twelve position, two deck rotary switch was used in my adapter. If you are building the original and the adapter as an SSTV only generator, some ICs may be deleted as pointed out.

In order to explain my adapter and the original circuit as it applies to my adapter, let me explain the terminology I have used. Since the ICs were not numbered in the original article, I will refer to them as follows:

1. Counters, #1, #2, #3 are the 74193 ICs left to right in the original article Fig. 1.
2. IC "1200," IC "1500," etc., are the gates identified by those numbers near their outputs. (Caution: The frequency found at these points is actually 2X that marked there.)
3. IC "SSTV" is the left 7430 with SSTV frequencies entering it, and IC "RTTY" is the right 7430 with RTTY frequencies entering.
4. The remaining ICs if mentioned are "final gate" for the 7402, and "output divider" for the last 7473.

Circuit Description

First let us decide what ICs can be removed from the original article should you decide to want an SSTV unit only. All 7430 ICs used on RTTY frequencies can go, i.e., IC "1445," IC "2295," IC "2975," and IC

"RTTY." Tie pin 5 to pin 6 on the IC "final gate" 7402. The 7402 has four gates, leaving two not used. IC "1275" and IC "2125" cannot be eliminated as they are part of IC "1500" used in SSTV, but just do not wire them up. This frees up two 3-input NAND gates, to be used differently.

With the extra ICs now eliminated, those retained in part can be wired as follows. First, use part of the 7410 as IC-20 in the adapter using the pins shown in my Fig. 2. Next, the gates I have shown as IC-19 (used as inverters) can be wired up using the extra two gates in the "final gate" 7402. Use the pins shown in Fig. 2 under "OPTION 7402." This has already eliminated two of the ICs I said you would have to buy. One more trick occurs. You can eliminate buying IC-21, a 7473, as well! This and the use of the 7402 unused gates are true whether you go SSTV only or keep the RTTY. This is due to the fact that only half of the 7473 is used in the original article as well. The pin numbers I have given for IC-21 in Fig. 2 allow you to use the other half. That drives the cost of the SSTV only unit down to buying a 7493 and a 7445, and only an additional 7410 for the SSTV/RTTY version ($1.53 or $1.71 respectively). It almost doesn't pay to leave off the adapter!

Now, following the signal through the unit, a 15 Hz square wave or pulse at TTL levels is fed from the monitor, camera or timebase you are using to the 15 Hz input point to IC-17, a 7493 pin 14. A word is required here, as you are probably used to seeing a decade encoder (7490) type IC driving a decade decoder (7445). The 7493 and some gating is used instead to allow very accurate width control to sync width on the gray scale pattern. The normal scan used in SSTV is a 5 ms scan and 1.6 ms sync and retrace period for the 15 Hz standard. This long sync allows for noise "masking" part of sync, etc., and is used much like the automatic line return on RTTY to insure a new line is in step with new information and not skewed. The 15 Hz standard yields a 120 lines times a 6.66 ... ms per line, or 8 second vertical period. With a ten line decoder it is convenient to use a nine or ten vertical stripe pattern, and I chose nine for two reasons. First it allows the generation of a 2300-2100-1900-1700-1500-1700-1900-2100-2300 format, nine stripe white to black to white pattern per Fig. 1. Since sync is "blacker-than-black," you can check your white to black transition response of filters, amps, etc., using the last bar. The use of the white and black bars for setting those levels is obvious and the same as a black or white only generator. Position "0" is left blank, and going to bar #1, white, will show both your overall response to noise in the filters, amps, etc., and another "rather" black to white transition. This is the sneaky reason for using a more than ten position encoder.

As the 15 Hz enters the encoder (counter), the encoder advances the decoder from "0" to the "1" to "9" positions producing the gray scale by gating on the proper tones via the electronic switches. The encoder then goes to position "10." As it leaves "9," that line going high again drives the output of IC-19 pin 6 low. That fall sets the J-K, IC-21, to a high on the Q output, and a low on the not Q pin 8 output that I used. That low turns on Q6 and the 1200 Hz sync tone. The encoder proceeds to positions "11" and "12." The decoder does not recognize any of the 10, 11 and 12 BCD inputs, so all the lines 0-9 stay high. As the encoder tries to go to "13," the BCD (binary really) output of the encoder 7493 is as follows: A = high, B = low, C = high, D = high. The A, C and D lines of the encoder are tied to inputs of a gate, IC-20, and when all are high as in position 13, the output of IC-20 pin 6 goes low. This low is used to pin 6 of IC-21, resetting it and turning off the sync tone after three positions of sync (10-11-12). The same low is sent to IC-19 used as an inverter. The high out from this inverter resets IC-17 encoder, and the entire cycle begins all over.

Using this arrangement, the width control on the monitor is used to set up the "0" noise position on the left edge of the screen, and the "black" of sync on the right edge. Since the minimum hardware was my idea from the start, you may see where as much as one line can be out of sync with the monitor, and this is quite true. The first sync tone puts everything in order, however, and this was not thought to be much of a

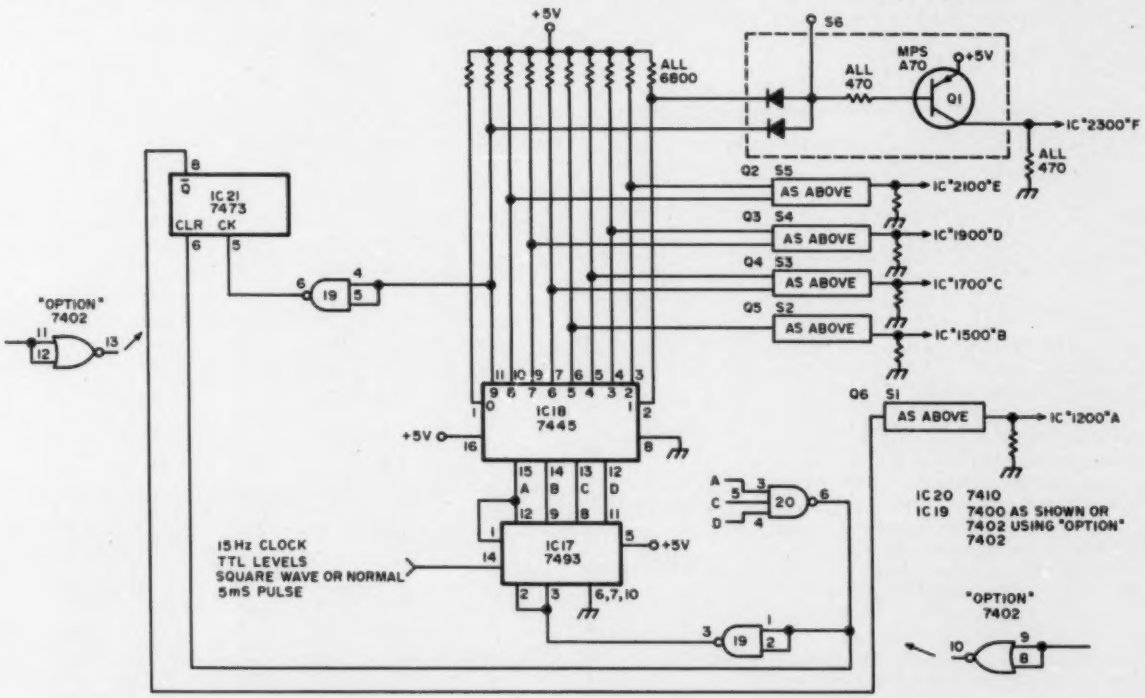

Fig. 2.

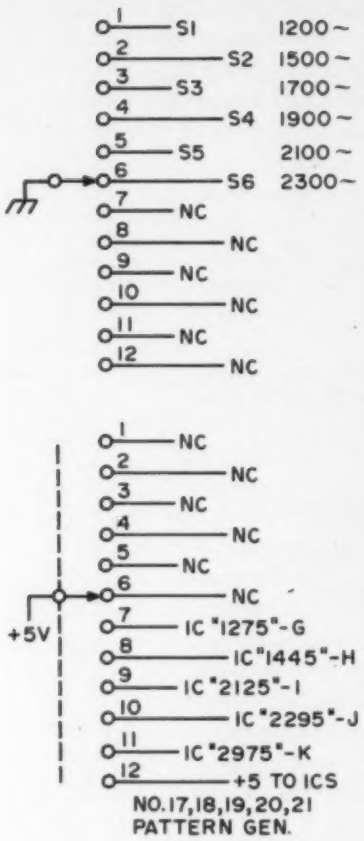

Fig. 3.

problem. In fact, I noticed it following the diagram through, and not in practice to begin with.

Using the adapter as shown, other variations are possible. The most obvious is perhaps to feed the one-per-eight second vertical sync to the 15 Hz input point and you have a white to black to white scan occurring at a one level per field rate, including one of no input. This works if the vertical sync provides your monitor with a return to start and follow new field capability (automatic retrace). Another easy use occurs if you want black/white stripes instead of gray scale. Instead of hooking the diodes up as shown, or by switching them around with a switch, the diodes can be hooked up as all decoder positions odd (1-3-5-7-9) go to electronic switch Q1 (2300 Hz), and all decoder even positions except "0" (2-4-6-8) go to electronic switch Q5 (1500 Hz). Leaving all else the same will give you a wh-blk-wh-blk-wh-blk-wh-blk-wh pattern or alternating white and black stripes. With a bit more tricky gating you can even get a checkerboard out of that one, but more on it later. By feeding the 15 Hz source to a simple divide by ten (7490) and the resulting 1.5 Hz to the 15 Hz input, a horizontal gray scale of sorts results. These latter patterns may not be in sync at first either, of course, for the same reason as the one line problem, but after one sync period all straightens out. Remember to feed the internal horizontal sync to the monitor when doing the vertical tricks, or very strange things happen. Think about it!

As to adapting the adapter, several cute tricks have been tried. I highly recommend you read also the article "Slow Scan TV Test Generator" by Bert Kelley K4EEU in *Ham Radio* (you know – the other mag – hi), July 1973, page 6. This was a TTL device also, and by feeding 2300, 1500 and 1200 Hz in proper timing into the circles lettered E, C and H, and then doing away with all of U1 and the half of U2 used as the sync oscillator, and not using ICs U9, U10 and U11, you can produce vertical, horizontal and checkerboard. The article will provide you with an H and V sync source if you are building a monitor or can't get to yours in a commercial version, and the filter at the end produces a pretty good sine wave in place of the square wave out of the WØLMD device. WØLMD mentions the filtering required, but did not include any, so I have shown the K4EEU filter as my Fig. 4. The 88 mH coils are the familiar telephone toroids and I included Bert's source hoping it is still valid. Several sources exist as I'm sure you are aware. *Don't* run to a transmitter without some filter or you may just regret it. Square waves contain rich hormonics FAR out into the beyond audio range, and TTL square waves seem to strive to get all of them – hi. A word to the wise?

Construction

Construction will vary with the builder as always, and the amount of parts hardly warranted a separate circuit board. I wired mine right into the original article using a particular type of perfboard that has the patterns for ICs and strips out from each pin and then hard wired the interconnects. It really doesn't take long if you use some logic to wire the logic (no pun intended). Wire +V, grounds, all 2048 leads, etc., and use a yellow pencil to mark out what you have done on a copy of the schematic. Construction is not critical, just time-consuming.

For those of you who have not already thought of it, by running three more 74193s from the same crystal source, using another 7410 to decode "1500" just as IC "1500" is wired, and using a divide by 2 (7473) to get a very accurate 1500 Hz just as the article did, but independent from it, you can add two simple divide by ten (7490) ICs and come up with a very accurate 15 Hz source. Another divide by 12 (7492) and divide by ten (7490) IC, just as in the K4EEU article, followed by 5 ms and 30 ms one shots (74121), and you get a very accurate one per eight second vertical sync source. With this you become the neighborhood SSTV "standard." For those of you who like accuracy or as a club project for membership use, this is only $6.52 more in ICs!! I tried it and like it so I'll pass it along, since it does not affect the rest of the operation at all. I'm building all of this into a deluxe monitor with built-in checks, so it comes out pretty cheap (common supply, cabinet, etc.). Use the third lead of the 7410 in the added divider chain to control on/off of this timebase. A +5 V applied to the original terminal "B" turns on and off both horizontal and vertical outputs from this timebase.

An SASE gets all the answers I can provide. Please try to be specific as to what you have/don't have, and where. Please address all questions about the original tone generator to the author. I almost became a K2OAW frequency counter expert (unknown drip under pressure!) over my follow-up "Garnishing a Counter" article, and it is not fair to the original author if I have to quiz him to get an answer, then relay it to you. Comments or further ideas regarding the original or my adapter are, however, very welcome if you send the author a copy for his use, too. We all can learn from these adventures – me, too! It's just not fair for me to get the credit, and sometimes be forced to give advice that may not agree with the author's original intent, such as known limitations, etc.

Have fun using your "gray matter" (source of infinite wisdom located – I'm told – somewhere between the ears) and your "Gray Matter" (scale) source. It sure is handy. ■

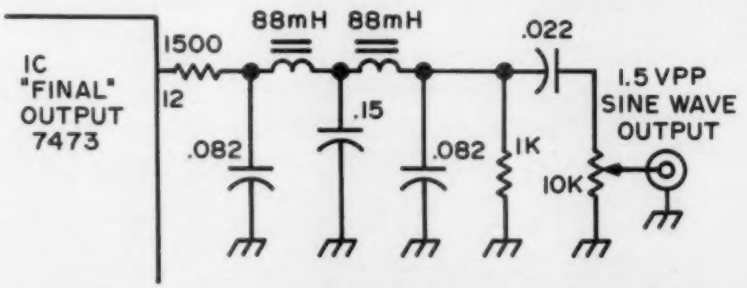

Fig. 4. Toroid source: M. Weinschenker, Box 353, Irwin PA 15642; 5 toroids for $2.00, postpaid.

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TR-22 Tips

As implied by the title, this article concerns tips directly applicable to the Drake TR-22 2-meter FM transceiver, but many hams (being the innovators that they are) will see value in applying these tips toward other rigs of similar design. Each of these tips has been tried and tested by the author and is workable; furthermore, none will detract from the appearance, operations, or re-sale value of the "stock" TR-22. Sound too good to be true? Please read on and judge for yourself.

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The first two numbers of the frequency are deleted for the sake of being non-repetitive. Example: 146.67 receive would be listed as —6.67R.

1. 6.01T	9. 6.13T	17. 6.19T	25. 6.31T	33. 6.52T	41. 7.03R	49. 7.15R	57. 7.27R	
2. 6.61R	10. 6.73R	18. 6.79R	26. 6.91R	34. 6.52R	42. 7.66T	50. 7.78T	58. 7.90T	
3. 6.04T	11. 6.145T	19. 6.22T	27. 6.34T	35. 6.55T	43. 7.06R	51. 7.18R	59. 7.30R	
4. 6.64R	12. 6.745R	20. 6.82R	28. 6.94R	36. 6.55R	44. 7.69T	52. 7.81T	60. 7.93T	
5. 6.07T	13. 6.16T	21. 6.25T	29. 6.37T	37. 6.94T	45. 7.09R	53. 7.21R	61. 7.33R	
6. 6.67R	14. 6.76R	22. 6.85R	30. 6.97R	38. 7.60T	46. 7.72T	54. 7.84T	62. 7.96T	
7. 6.10T	15. 6.175T	23. 6.28T	31. 6.40T	39. 7.00R	47. 7.12R	55. 7.24R	63. 7.36R	
8. 6.70R	16. 6.775R	24. 6.88R	32. 6.46T	40. 7.63T	48. 7.75T	56. 7.87T	64. 7.99T	
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The first tip has to do with knowing when your TR-22 is on or off. Maybe this has never been a problem for you...yet. It was for me one day when I accidently left mine on with no antenna connected and squelch fairly tight. The squelch on these radios is excellent, so good in fact, that it is impossible to tell if the rig is on or not unless a signal of sufficient strength is present to break the squelch. The only way you will know that is when the battery pack has run down enough to break the squelch by itself and at that point the batteries are dangerously low. Remember what Peter Stark K2OAW said about nicads in his excellent article in December 74, *73 Magazine*? My TR-22 on-off indicator is a jumbo diffused red LED (light emitting diode) with an appropriate series current limiting resistor. The LED can be run at fairly low light output (which is also low current drain) and still be effective in its purpose. I am using a 390 Ohm, ½ watt resistor in series with the LED and end up with

Light Emitting Diode on front panel.

about 25 mA additional current drain from the batteries. Normal TR-22 receive current drain under squelched conditions is about 45 mA and will peak to 100 mA or so depending upon the setting of the volume control when audio is present. Since the "stock" batteries are 450 MAH units, I felt that the additional 25 mA drawn by the LED was

Broom holder for use as mike clip.

well worth the added protection. By the way, it has been my experience that not all surplus LEDs give out the same amount of light output per current input. You may very well find that you can increase the series resistor (lower the battery drain) by picking and choosing thru several LEDs which I did in the first place.

I located my on-off LED in the upper right-hand open area of the front panel just to the left of the earphone jack, and it looks like "it come outa da box that way." See photo. One 3/16" dia. hole is all that is needed for mounting, but first drill a smaller pilot hole and loosely place masking tape around where the drill will come thru the rear of the panel to catch the filings. Once the LED fits nicely and the hole has been de-burred both sides, a couple of drops of epoxy will hold it in place forever (thank goodness LEDs last that long).

The wiring is easy, only two connections to the TR-22 are needed and one is right next to the LED. The easiest place to pick up ground is from the "sleeve" or outer connection of the earphone jack. The negative (cathode or flatted side of the LED) is connected to this ground thru the 390 Ohm, ½ watt resistor. The positive (anode) of the LED is connected to switched hot 12 VDC; I ran a red wire to point "B" on the receive board which is located at the center rear of that board and is clearly marked. Just wrap the tined end of your wire right around point "B" and solder (no need to remove boards, etc.). That's all there is to it. Go into the nearest closet, raise someone on the local repeater, and tell him at length how great it is to be able to fill out your log by the light of an LED. You will now be able to tell at a glance if your TR-22 is on or off and even if the batteries are

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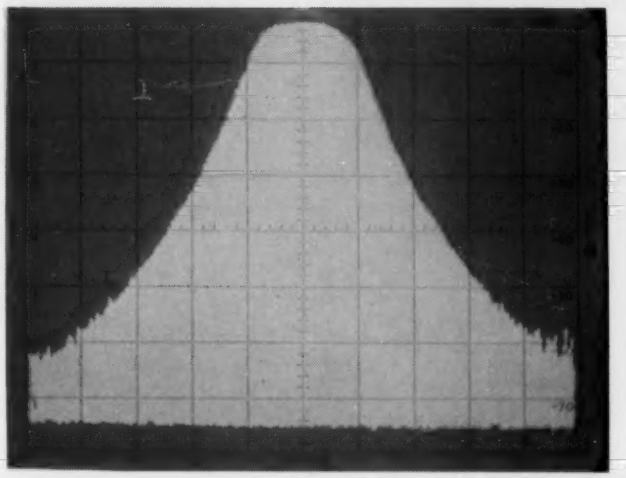

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starting to drop off (with experience of course).

Tip number two has to do with adapting a heliflex (rubber ducky) antenna to the TR-22 so that the ducky comes out the top instead of the bottom (ever try to set your TR-22 down on a table with the PL-259 type ducky coming out the bottom?). The first problem here is to not, repeat NOT destroy or in any way modify the existing telescoping whip antenna. Impossible? No, just a little ham ingenuity. I cut the PL-259 connector off of my ducky leaving enough metal at the base to deftly solder on a metal plate cap from an old color TV set which just happens to fit over the conical tip of the existing TR-22 "stock" whip antenna. A piece of heat-shrink tubing over the exposed metal sealed the job from accidental contact with anything else metal. It works like a charm, well, like any rubber ducky works like a charm. Don't fret about the length of telescoped whip inside the metal TR-22 case which now just acts like a piece of transmission line, because it now just acts like a piece of transmission line (at least it's terminated which is more than you can say when using the ducky on the rear connector).

The third tip involves the microphone holder supplied with the TR-22. My TR-22 is the earlier model with the slim pencil mic (which I really like but it can no longer be purchased from Drake). The original mic holder was a plastic cable harness clip which broke instantly (or almost so). I purchased some "C" shaped metal broom holders from the hardware store (you know the type that fasten to the wall and a broom handle can be snapped in), gave one a coat of polyurethane varnish, drilled and tapped a single 10-24 hole in the TR-22 case on the right side midway in both dimensions, and fastened the broom-handle-holder with a minimum length screw. See photo. This holds the pencil mic proudly and indestructibly.

The fourth and final tip will keep your TR-22 batteries up-to-par at all times without overcharging, overheating (remember Pete Stark's article) or shortened life. The key phrase is a "trickle-charge option," once again without destroying re-sale value or digging too deeply into the original well-designed unit. This modification merely involves installing a 15K

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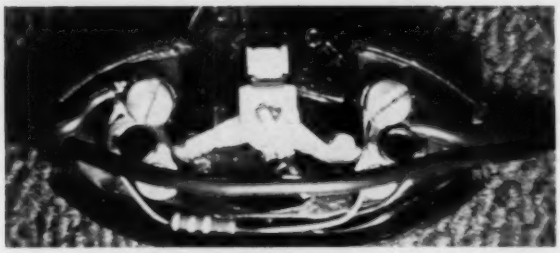

Trickle-charge switch on line cord.

Ohm, ½ watt resistor in series with the AC charging cord and an in-line switch to short out said resistor when full charging is desired. Full charging for the TR-22 measures 30 mA on my unit which is safe (less than 1/10 capacity) for 450 MAH batteries, for 14 to 16 hours, but the 15K series resistor in the line cord cuts this to 7 mA which is a good "keep-alive" current to compensate for the nasty self-discharge tendency of nicads on stand-by. The in-line switch I used (local hardware store again) is a SNAPIT 10A at 125V unit in which I was able to comfortably mount the resistor right across the switch screws and still pass the line cord (one conductor also attached to the two screws). See photograph. In action, of course, the switch either allows the resistor to be in series with the AC input (switch off) or it shorts out the resistor for full AC input (switch on). Dymo tapes take care of remembering that rather backward type logic (for me anyway). If you are adverse to even modifying the "stock" AC line cord for the TR-22, a standard TV "cheater" cord with the ears slightly trimmed will work in the radio as a charging cord which would be modified in the same manner. Now things don't get much cleaner than that!

In conclusion, it is my hope that these relatively easy modifications will bring you even more enjoyment from an already well-designed, well-constructed and very popular transceiver as they have for this writer. Each of the tips is a "one evening kit" as the Hams at Heath would say, and you will also have the satisfaction of home-brewing something while proving that Wayne was right when he said that Hams are not appliance operators but build what they cannot buy. ■

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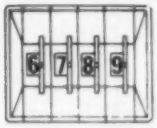

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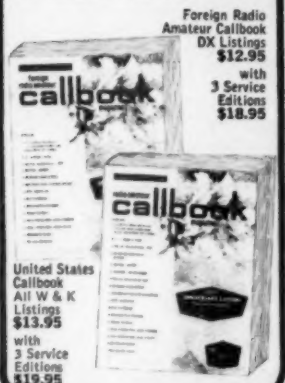

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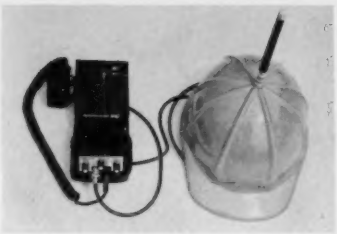
Safety helmets or hard hats are generally associated with the construction industry, but it is very obvious that our pretty model, Mary Hessell, does not need any work in that department. However, if you look at the top of the hat that Mary is wearing, you will notice that she has an antenna up there. If you are at all familiar with 2 Meter FM, you will recognize the common rubber flex antenna, helical whip, rubber duckie, banana, or one of the other names that it is fondly (and sometimes, not so fondly) called.

While this idea of an antenna on a hat is not original, we did do some experimenting and have come up with a pretty efficient performer and we can give you a few examples where you will have to agree that the whole idea is very practical.

Everybody likes a handheld transceiver. Even if you have a good mobile and base station, there is nothing like a compact rig



An upside down view of the Clegg HT-146 shows how it looks on the operator's belt.

that you can carry with you around the yard, garage or basement to keep up with what the rest of the gang is doing. If you are going to a swap-and-shop or hamfest, they come in very handy. For Civil Defense, RACES, AREC work, or serving your own community by providing communications for a parade, boat race, or an emergency, they are an invaluable tool.

The best way to carry your rig is on your belt in its own leather case, because it can get quite awkward after a while if you tote it in your hand. This of course makes an external mike the handiest accessory for it that you can have, as you can then operate it while it is still on your belt. Either the built-in speaker will suffice, or you can imitate Walter Cronkite or John Chancellor, and put a button in your ear for private listening. Or, perhaps your rig has a separate speaker-mike combination.

But there is still one big hang up. That rubber duckie antenna working in the vicinity of your navel has little or no efficiency, and your chances of being heard are very poor. The best remedy for the situation is to get it up in the air a little higher as any ham knows from experience. You could carry a six foot step ladder around with you, and if you get one of the new aluminum ones, they are fairly light. But there is an easier way: Mount your antenna on the top of a hard hat.

Safety helmets like this have become a fairly common thing in today's society, as the government agency OSHA is requiring them to be worn any place where head injuries are at all possible. Therefore, we can buy them very readily in most any community. We went to a local safety equipment dealer and found a selection of about five grades, prices and colors ranging from about $2.50 to $6.25 each. The one

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□ **6 WPM** This is the practice tape for the Novice and Technician licenses. It is made up of one solid hour of code, sent at the official FCC standard (no other tape we've heard uses these standards, so many people flunk the code when they are suddenly – under pressure – faced with characters sent at 13 wpm and spaced for 5 wpm). This tape is not memorizable, unlike the zany 5 wpm tape, since the code groups are entirely random characters sent in groups of five. Practice this one during lunch, while in the car, anywhere and you'll be more than prepared for the easy FCC exam.

□ **14 WPM** Code groups again, at a brisk 14 per so you will be at ease when you sit down in front of the steely eyed government inspector and he starts sending you plain language at only 13 per. You need this extra margin to overcome the panic which is universal in the test situations. When you've spent your money and time to take the test you'll thank heavens you had this back breaking tape.

□ **21 WPM** Code is what gets you when you go for the Extra Class license. It is so embarrassing to panic out just because you didn't prepare yourself with this tape. Though this is only one word faster, the code groups are so difficult that you'll almost fall asleep copying the FCC stuff by comparison. Users report that they can't believe how easy 20 per really is with this fantastic one hour tape. No one who can copy these tapes can possibly fail the FCC test. Remove all fear of the code forever with these tapes.

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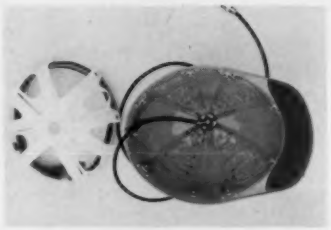
73 Magazine – Peterborough NH – 03458

that we chose is the more expensive variety and is made of Lexan, which is pretty tough plastic. The better ones have easily adjustable headbands that can be removed and replaced very simply. One of these made the logical option for us because comfort is the number one consideration for our application, and we have some goodies to add to the inside.

The hand-held rig that we are using is a Clegg HT-146, and it has several features that make it well suited to work with the hard hat set-up. The external mike plugs into the top of the unit with a telephone-type plug and is large enough to use easily, but not bulky and cumbersome. When you are not transmitting, it clips to the hanger on the leather case and the coil-cord keeps everything neat and out of the way. The antenna output is to a BNC, and it takes but a second to take off the rubber duckie and connect the coax to the hat, or even to the 5/8ths on the car.



The zigzag pattern of the four radials gets lots of wire inside.

In addition to improving the antenna height for better transmission, we added radials to the inside of the hat to get a good ground plane. After drilling a hole in the top center, we mounted a BNC chassis connector. On the inside, a large thin washer with holes drilled in its edges was placed under the connector before tightening it. This is for the solder connections of the radials and coax braid.

We made several attempts at a pattern for placement of the radials, but finally used the zigzag pattern as shown in the photo. This method provides maximum spacing in keeping the radials away from each other, but still gets the most wire possible inside. We have about 23 inches on each of the four legs, or enough to accommodate a ¼ wave whip on the top of the hat, if you wish.

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These cards are ganged up into large batches and run off the 73 presses in between other work, so you don't get real fast delivery, but you do end up with a fantastic QSL at a ridiculously low price (and there are a lot of fans for that sort of service these days).

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K	AD
WD	AE
WR	AF
WN	AK
KB6	AG2
KC4	AL4
KG6	AG6
KH6	AH6
KJ6	AJ7
KL7	AL7
KM6	AH7
KP4	AJ4
KP6	AI0
KS4	AH4
KS6	AH3
KV4	AJ3
KW6	AG7

The radials are permanently attached with epoxy, after holding them in place temporarily with masking tape. We used epoxy on the edges only and used the five minute setting type. The longer timed stuff had a tendency to run down to the bottom of the hat before hardening, because upside down, it is just a big dish.

After soldering the braid and wires together at the base of the connector, we soldered the center conductor, and drilled a hole in the back edge of the helmet for a strain relief clamp to protect the coax line. Then we replaced the liner and the entire project was finished.

It does its job well, though admittedly it is kind of a funny looking thing. You can help this somewhat by adding a little art work if you are handy with a paint brush. Your call letters, handle, and even home QTH would be appropriate to put on the front or side. If you can't paint it, you can buy stick-on letters in any stationary store in dozens of sizes.

Here's another application — if your club or repeater group is called upon very often in your town for traffic control for parades and civic events, you could have all the members make up these hats all in the same color. They would allow you to use your HT's practically hands free, and give you all a uniform type image. Pretty good PR for ham radio.

In the beginning, we only promised you a way of operating your hand-held rig from your belt without carrying a step ladder around with you. If enough hams start using something like this, they could catch on until someone comes up with a better idea. But at least you have to admit it's practical!!!! ■

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How often have you considered building a new unit to add to the shack and wondered —

Is the cost of the materials worth the effort?

Will it fit on a chassis I have on hand?

How about a cabinet?

What layout will be best?

Well don't think you are alone with these thoughts. Many builders in this day and age consider these factors before starting on a project. This I believe is one of the prime reasons responsible for the "Black Box" routine so readily followed now.

But I have found a use for copper clad board around the shack that puts the challenge back in home building and is a source of never ending delight when new ways are found to use this blessing to the home builders.

The use of copper clad board may not be new to many of the homebrew

generation, what with all of the solid state construction that is going on in the industries throughout the world, and of course the use by the home building group in constructing their projects, but most have been the etched variety of construction.

Have you tried using this same material as you would aluminum, brass or copper sheet when building converters or other types of bread-board construction? I have been truly amazed at the various uses that this type of material can be put to.

It is by far the simplest material to work, as a pair of tin snips can be used quite successfully to cut the material to the desired size without injury to the material. It readily accepts solder and can be cut to form boxes, shields and what not.

One of the principal joys of using this material is the one of short leads and direct ground connections (the ones that generally get us into trouble), along with easy access to the parts.

It is easy to fasten parts to the board. For instance, with a tube socket simply punch the hole in the right location, position the socket for the shortest lead length, then solder the socket tabs to the copper clad. There are no screw holes to position and drill, and no looking for the right size nut and bolt to hold the socket in place.

As for standoffs, tie points or feed thru points, well, the surplus market is still loaded with boards that have those fine teflon bushings by the score. Simply unsolder the connections to them and push them out of the board. As you find a need for them, simply drill the right size hole and insert the type you require in that location.

The use of this material around my shack has given me a new lift on home brewing. Securing the right size chassis for a new idea that I wanted to try was becoming quite a bit of work. It is much easier to use a bit of beat up material that already has lots of holes in it to start with.

A supply of this material can be had for those fortunate enough to live near an electronic manufacturing plant for scrap copper prices. Since not all the units are perfect in manufacturing and quite a bit of this material goes into the saleable scrap, most of these outfits are quite willing to part with this material.

I hope you have as much enjoyment using this method of building as I have, for we can sure use more constructors in our ranks. ■

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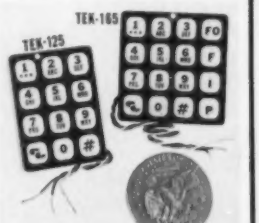

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Everyone must have seen those "Bicentennial Minutes" that follow their favorite programs in the evening. Well, after viewing these for quite some time it has become obvious that ham radio's part in history has not been shown and has been well hidden.

After some extensive and exhaustive research, we have uncovered some of ham radio's unheralded facts about the birth of our nation.

In honor of our 200th birthday, 73 is proud to be the first to publish these little known and soon forgotten "Bicentennial Seconds":

Contrary to popular belief, the revolutionary war did not start over "Taxation without representation," but rather the reason being that the colonists believed that America should receive separate country status because it lies more than 200 miles off the coast of England.

History tells us it was Paul Revere that devised the lantern scheme to warn which way the British were coming. The truth is that it was a lad named Morris who, at a Sons of Liberty Repeater Association meeting, thought up the "one if by land, two if by sea" that quickly became known

among the patriots as the Morris Code.

Paul Revere allegedly rode his horse around the countryside to warn of the approaching British. Actually, he never left the comfort of his shack, and used his Handy-talkie on the Minuteman repeater to warn each town and hamlet.

Thomas Jefferson did not only write the Declaration of Independence and the Bill of Rights. He also was largely responsible for the Communications Act of 1774 which established incentive licensing in early America. It called for only two classes of amateur license. The Patriot class included all amateur privileges. The Tory class permitted only five watts input on 27 MHz.

After this didn't work out too well, Thomas Paine was asked by the F.C.C. (First Continental Congress) to write a Docket of Proposed Rulemaking which he entitled, "Common Sense."

Benedict Arnold, in addition to treason against America, also was the first to be convicted of cheating on Field Day. He used ac power rather than portable power.

The Liberty Bell, symbol of Freedom, almost didn't have a home until the Philadelphia Tinkerbelle Repeater Association relinquished their site atop Independence Hall for the Bell.

The Boston Tea Party was supposed to have started over the high taxation of tea. The truth is that the Party started as a friendly hamfest, but when the R.S.G.B. announced a dues increase and a 10 pound charge for their awards program, the Colonists decided to form their own league and a melee ensued.

Patrick Henry's original quote in front of the VA Legislature was, "Give me separate country status or give me death!"

Benjamin Franklin made many contributions to the war effort and in addition made many inventions. One stormy day after Franklin had been flying his kite he informed his fellow OM's that he had invented the electronic key.

General Lafayette almost didn't come to aid the Americans because he was refused reciprocal operating privileges. However, Lafayette changed his mind and decided to come after he was promised he could open a radio store in New York at the conclusion of the war. ■

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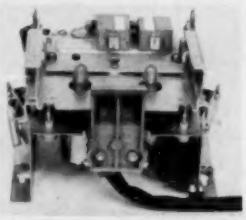

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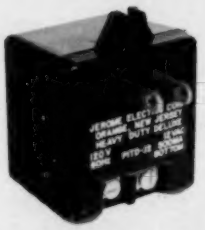

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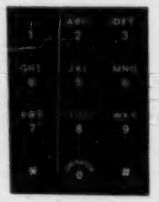

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San Jose, Ca 95128
CALIFORNIA RESIDENTS ADD SALES TAX

Phase Locked Loops

LM565CN $1.10 ea $90.00/C

OTHER SEMI'S

2N494	.25 ea	20.00/C
SN7438N	.25 ea	20.00/C
SN7451N	.10 ea	15.00/C
LM301HA	.25 ea	20.00/C

TRIAC ASSEMBLY

S100F2 VARIABLE VOLTAGE CIRCUIT
6 amp. 240V RMS
L-C Network for RFI Suppression
Uses – Motor speed control
– Lamp dimmer
– Heat control
Unit is assembled in an aluminum, electrically isolated heat sink. 1" X 2" X 3". Requires only a 500K Ohm external control device.
SPECIAL ONLY $8.36

THREE-LEGGED BRIDGES

Manufacturers' Rejects
FULL WAVE BRIDGE RECTIFIERS
One leg open in each bridge. Has 3 good 25 Amp Diodes. PIV at least 100 V to 800 V
Use for full wave C.T. bridge. Parallel 2 cells for 50 Amp diode $.35 each . . . 10/$2.50 100/$20.00

RECTIFIER TRANSFORMERS

SIGNAL 36-4 Pri: 115 V 60 Cy.
Sec. #1: 18 VCT 4 A
Sec. #2 18 VCT 4 A
Shipping wt. 8 lbs $8.95

TRIAD F-67U Pri: 115 V 60 Cy.
Sec. 24-27-30-33-36 V 8A
Shipping wt. 9 lbs $12.95

TYPE FV-500 115/230V 60 Cy.
Sec. 30 VCT 4 A
Shipping wt. 8 lbs $7.95

HELITRIM 77PR1K 1000 Ohm trimmer Cermet. 15 turns $.80 ea., 10/$7.50

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ELECTRONICS CORP.

LM-D-15 15 Vdc ± 5% 9 Amps.
Regulation .03%, 1 mV ripple
4 15/16" X 7 ½" X 9 3/8"
SPECIAL NEW $95.00

LM-E-5 5 Vdc ± 5% 20 amps.
Regulation .03% 1 mV ripple.
4 15/16" X 7 ½" X 11 ⅜"
SPECIAL NEW $110.00

LM-EE-15 15 Vdc ± 5% 10 Amps.
Regulation .03% 1 mV ripple.
4 15/16" X 7 ½" X 16 ½"
SPECIAL NEW $105.00

LRA-6 RACK ADAPTERS.
Will fit any two A, B, C, CC, D, E.
5 ¼" X 19" X 14" $30.00

LRA-7 RACK ADAPTERS.
Will fit any two A, B, C, CC, D, E, EE.
5 ¼" X 19" X 21" $35.00

WANLASS

TYPE 30-OEM-1
DC POWER SUPPLY
AC Input: 105-125V., 10 60 Hz DC Output: 3.6-9.0V. @ 30W or 2.5 Amps
Regulation: ± 1% Line, ± 1% load
Ripple: 0.1% ± 10 mV RMS Max
Size: 5" X 5" X 5"
Shipping wt. 6 lbs ..... $29.95 each

TRANSISTOR TRANSFORMER

UTC DO-T22 Pri: 1500 Ohms CT. 3 mA.
Sec: 600 Ohms, SPECIAL ... $3.95 ea.
10/$35.00

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106 W. 7th AVENUE,
TRAPPE, PA 19426
(215) 631-1050
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SUPER SYNTHESIZED SCANNER

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10 Channel. LO VHF 30-50 MHz. HI VHF 146-174 MHz. UHF 440-512 MHz. Mfg. price $329.00

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MS-2 16 channel. 31.18-50, 146-148, 151.18-170, 451.2-470, 490-508.825 MHz. Mfg. price $339.95

BEARCAT 101

Covers 16000 Public Service Frequencies including 2 and ¼ meter Ham Bands. Mfg. price $349.95

30-50 MHz; 146-174 MHz
450-512 MHz

Write for info on Porta Clip — Carry your Handie Talkie the easy way. Prices $6.50 up

Regency ACT-R 10 H/L/U with ten free crystals . . . $169.00. *
Regency or Bearcat high accuracy monitor crystals . . . $3.75.
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HIGHEST PERFORMANCE!
LOWEST PRICES!

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The **FM-76** for 222 MHz
10 WATTS

These two new Clegg FM Transceivers offer the highest QSO per dollar value for the FM'er. Both are 12 channel, .35 uv sensitivity units with such extras as individual trimmers for netting both transmit & receive xtals.

Either unit only $189.50 with microphone and 1 set xtals.

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LOGIC PROBE KIT

$14.95
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New! A Digital Logic Probe kit at a realistic price. Red, Green, and Yellow light emitting diodes signal the presence of logic levels encountered in digital circuitry. Utilization of transistor and integrated circuit switching techniques permit the DIGAPEAKE-A to indicate logic 1, logic 0, and pulsing circuit conditions. Complete kit including easy instructions is available now from ...

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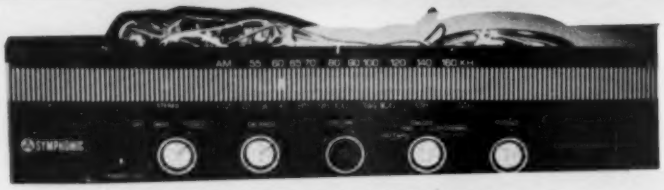
NEW!



AM-FM STEREO TUNER AND AMP

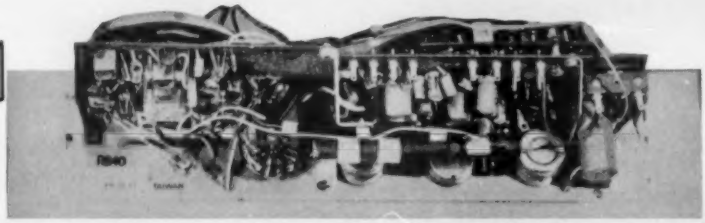
Fit this new receiver with slimline design into your next project. Thousands of these units were sold in stereos from $79.95 compacts to $275.00 consoles.

This is a complete, tested, new and guaranteed system, at a closeout price. Includes FM antenna, power transformer, ac cord, schematic & instructions, wiring harness and jack plate. Shipping weight 5½ lbs. 12"x3"x4" deep.

WHY RUN WIRES–GET ONE FOR EACH ROOM

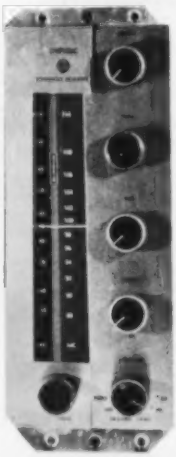
Order #R845 AM-FM Stereo Receiver $28.50
Order #2R845 Get two now and save $9.00 ..... 2/$48.00

12 VOLT



SAME AS #R845 except this is an AM-FM tuner and stereo amp only (no power transformer), runs on 12 volts dc. Use this tuner in your van camper or auto. Has extra input terminals, schematic and instructions. Sh. wt. 3 lbs.

Order #R840 AM-FM tuner and stereo amp $18.50
Order #2R840 Buy two and save ..... 2/$32.00



SUPER FRONT END

22 WATTS PEAK AUDIO OUTPUT

AM-FM STEREO RECEIVER

Can be built into a wall, a bar, your own custom cabinet, or be used as a replacement unit in an existing installation. Features – separate bass and treble controls, sensitive front end, phono, tape and auxiliary inputs. With this system you get an FM antenna, wiring harness, jack plate, ac cord, faceplate, knobs and instructions.

NEW-TESTED-GUARANTEED

Order #R817 AM-FM Stereo Tuner & Amp .. $38.50
Order #2R817 Buy two and save more .... 2/$68.00
Shipping wt. 8 lbs. 12"x5"x7" deep.

Viatron communications adaptor with EIA-RS-232C connector output for 8 level serial ASCII. Includes wired and tested circuit boards, face plate, cable and manual. PRICE: $165.00. With purchase of Viatron 2111 System, only $65.00.

Verada 214, 38 French St., Box 438, Lowell Ma. 01852 Tel. 617-458-3077

VERADA 214

All parts are removed from functioning equipment. Guaranteed functional. If you are building a CRT monitor for any purpose these parts are ideal. Please include $2.00 to cover handling and insurance on all orders. Minimum order $5.00. NO COD. Send check or money order plus estimated shipping. Excess will be refunded.

CRT for VDT
12' P31 phosphor, extremely small spot size, approx .002" when properly focused. Removed from functioning VDT — guaranteed wt. 10 lbs. **$14.99**

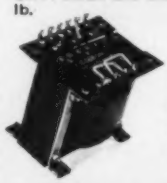
Socket *(not shown)*
Fits above CRT (with leads) wt. ½ lb. **$.99**

Yoke
For above CRT — less than .1 ohm dc resistance, very low inductance perfect for high deflection rates and write speeds. Used in modern VDT for stroke-type graphics and alphanumerics. Perfect for any VDT, SSTV or similar monitor. With four long leads and connectors. Wt. 4 lbs. **$12.99**

High Voltage Power Supply **NEW!**
This is a unit designed & manufactured by SUNTRONIX using component parts from the (Sanders) 708 Display. Generates 15 kVdc, 950 Vdc & -150 Vdc for the above CRT. Includes socket for CRT, connector for input voltages, high voltage lead and connector for the CRT anode and requires no input drive signal — self starting. Needs + and - 15 Vdc and + 5 Vdc. Ideal for the monitor or VDT you're building. This is NOT the Sanders HVPS, but a brand new design utilizing component parts from the Sanders HVPS. Wt. 6 lbs. **$29.99**

HVPS XFMR
This is a fly-back type transformer and is used in the SUNTRONIX HVPS described above. We'll supply schematic information for constructing your own HVPS. Wt. 3 lbs. **$5.99**

HVPS Rectifies Assy
This little gem will take 15kV ac and turn it into 15 kVdc, filtered and ready for the CRT. Small size and SOLID STATE. Wt. ½ lb. **$3.99**



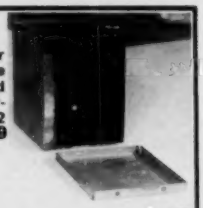
Low Voltage Power XFMR
Provides all low voltages needed by the homebrew VDT or monitor. Dual 115 Vac primary, 30 Vac, 22 Vac and 12 Vac, all C.T. and 10A, 5A and 2A output currents respectively. Wt. 8 lbs. **$8.99**

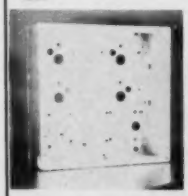
Filter Caps
Two values — 36,000 @ 30 Vdc and 47,000 @ 25 Vdc. Should use two of each for a + and - 15 Vdc and + 5 Vdc supply. Wt. 2 lbs. ea. **$1.99 ea.**

Heat Sinks
Four of these were used in the deflection amplifiers. Each sink will handle approx. 150 watts drilled for T0-3 transistor. Wt. 2 lbs. ea. **$1.99**

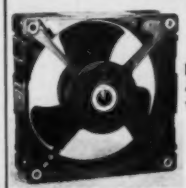
Transistors
LVPS pass transistors MJ2267 & MJ2255; each good for 150 watts @ 40 vcbe. Deflection output transistors 2N5301 & 2N4398 also 150 watt units. **$1.99 ea.**

Mu-Metal Box w/cover
This is a must if you plan to mount your power supply xfmr on the same chassis as the CRT. XFMR above fits this box perfectly and will prevent problems with magnetic interference between the CRT and XFMR. Wt. 2 lbs. **$2.99**



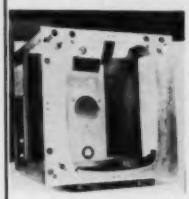


Power Supply Case
This is the Cadmium-plated power supply enclosure used on the 708. Made of steel, cadmium plated for corrosion resistance and magnetically shielded. Supplied with front and rear covers. All holes drilled to install the above LVPS components. Available with three bridge rectifiers, three pass transistors and input/output plugs or stripped. wt. w/covers 10 lbs. — without covers and rectifier parts. Wt. 8 lbs. **$8.99**



Muffin Fan
4" ROTRON muffin fan for cooling those warm transistors. Wt. 3 lbs. **$3.99**

XFMR IC PS **NEW!**
Completely enclosed with long leads. 115 Vac primary, 12 Vac @ 3.0A and 135 Vac @ 50 mA. Good for general purpose bench supply and for high voltage requirements for nixie or gas-discharge displays. Wt. 3 lbs. **$3.99**

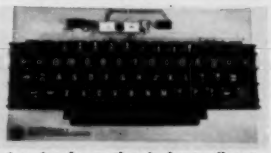


CRT Chassis
This is the basic enclosure for a 12' CRT. Includes front mounting plate to hold the CRT (with metal mounting ring), plastic decorative bezel that clips into front plate and provision for mounting the yoke (above). Has plenty of additional space for support electronics and provision for mounting the LVPS enclosure described above. Will save you days of sheet metal work. Available with or without bottom mounting base and plate. **w/o base, 10 lbs. — $15.99**
w/base, 15 lbs. — $19.99

Cover
This is the wrap-around cover for the above components. Painted, has hinged rear cover plate for easy access to internal components. wt. 15 lbs. **$7.99**

Sanders Keyboard
This is the Sanders 720 ASCII keyboard so much in demand and now available at this low price only from SUNTRONIX. These units are of various configurations; some have numeric pads separate from the main keyboard, others have the numbers as part of the keyboard with control functions as a separate grouping. Sorry — no choice available. All units sold as-is and priced for a quick sell-out. As before, when these are gone, there will not likely be more . . . order early to avoid missing out. Wt. 9 lbs. **$39.99**

Suntronix Keyboard KBD IV
This is a brand new SUNTRONIX designed and manufactured unit described in the last several issues of 73. These units are rapidly becoming the standard keyboard for many of the Mup units being offered by others. Naturally, their price includes their mark up on the KBD-IV. Save a few dollars and order from the designer direct. Sorry, due to lack of interest kits are no longer available. Factory assembled units will be sent postpaid for $74.95. Naturally, the unconditional 90 day warranty applies along with full documentation and factory back-up. **$74.99**



All prices are subject to change without notice. Availability on some items is limited. All items are subject to prior sale. No backorders — if we're out of stock for any reason your money will be instantly refunded. Master Charge and BankAmericard accepted. All prices are F.O.B. Lawrence, Massachusetts (you pay shipping). SASE for info.

SUNTRONIX COMPANY

360 Merrimack St., Lawrence, Mass. 01843
Factory Telephone 617-688-0751

master charge

BANKAMERICARD

INTER-OFFICE MEMO

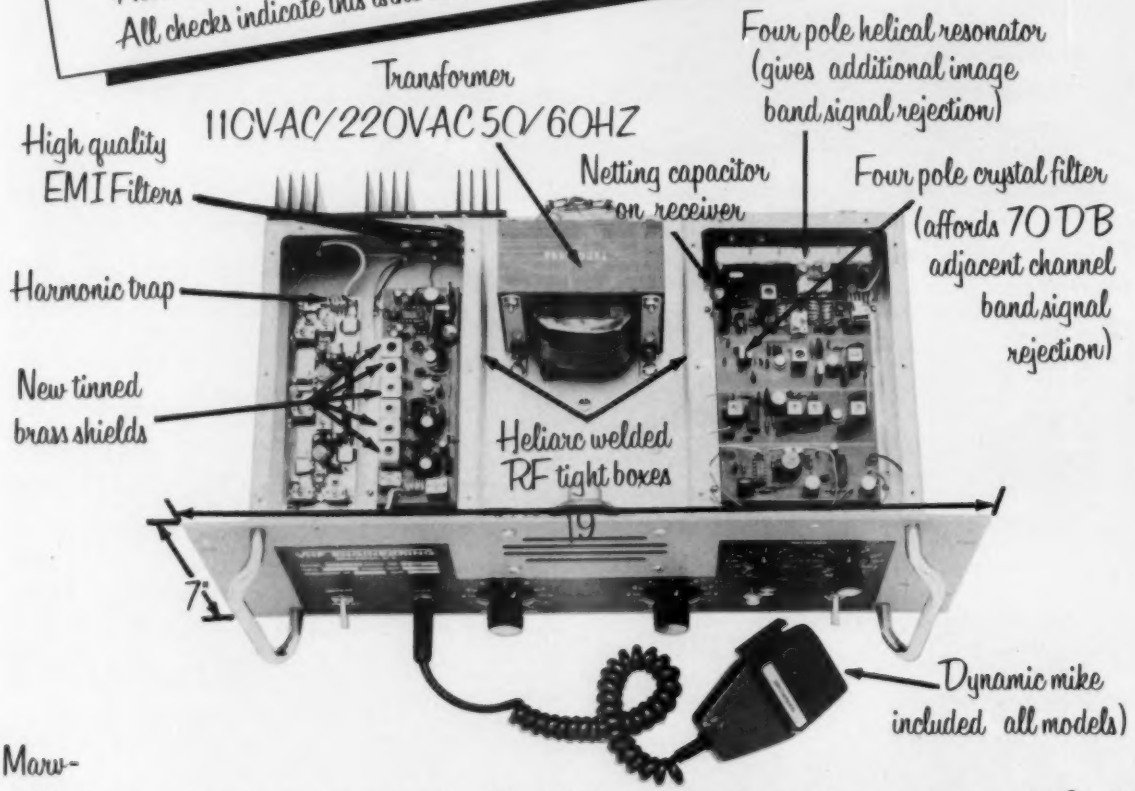
TO: MARVIN DRUSKOFF, General Manager

DATE 12/1/75

FROM: ROBERT BROWN, Chief Engineer

Here is the information on our new "B" series of repeaters. All features are standard on all units; kits as well as wired. All checks indicate this is the hottest repeater on the market.

Standard features on all repeaters (Kit or Wired & Tested) B series.


Transformer
110VAC/220VAC 50/60HZ
Four pole helical resonator (gives additional image band signal rejection)
High quality EMI Filters
Netting capacitor on receiver
Four pole crystal filter (affords 70 DB adjacent channel band signal rejection)
Harmonic trap
New tinned brass shields
Heliarc welded RF tight boxes
19
7"
Dynamic mike included all models)

Marv-

Not shown in photo is new power supply. Has fold back current limiting (you can short supply & will not damage it), also over voltage protection (a short in the supply will shut it down so repeater is not damaged.) Don't forget our CWID with its 159 bit field programable memory.

Bob

PRICES

RPT 144B Kit . .	repeater — 2 meter — 15w — complete (less crystals)	465.95
RPT 220B Kit . .	repeater — 220 MHz — 15w — complete (less crystals)	465.95
RPT 432B Kit . .	repeater — 10 watt — 432 MHz (less crystals)	515.95
RPT 144B . . .	repeater — 15 watt — 2 meter — factory wired and tested	695.95
RPT 220B . . .	repeater — 15 watt — 220 MHz — factory wired and tested	695.95
RPT 432B . . .	repeater — 10 watt — 432 MHz — factory wired and tested	749.95

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Vhf engineering

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DIVISION OF BROWNIAN ELECTRONICS CORP.

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Your choice of any kit $7.98

THE BIGGEST INFLATION-FIGHTING VALUE EVER!

TEST 'EM YOURSELF 'N SAVE!
Every kit carries money back guarantee.

For the first time anywhere, Poly Pak merchandisers introduce a new way in buying the economical way. Raw stock from the "barrel". Remember the "good ole days"? They're back again. The same way merchandisers throughout the United States buy from various factories . . . their overruns in barrels. Poly Pak has done the same. Therefore you are getting the same type of material as the RE-TESTERS DO!

BARREL KIT #1
SN7400 DIP IC'S
75 for $1.98
Marked 14 and/or with 16 pin dips, may include gates, registers, flip flops, counters. Who knows! GUARANTEED SATISFACTION!
Cat.No.4A2415 Untested.

BARREL KIT #2
LINEAR OP AMPS, DIPS
Untested 75 for $1.98
May include 709's, 741's, 703's, 560 series, 555 includes marked and unmarked. Cat.No.4A2416

BARREL KIT # 3
1N4148/914
SWITCHING DIODES
100 for $1.98
You never saw this before. Imagine famous switching diodes at these prices! Cat.No.4A2418 Untested.

BARREL KIT #4
"4000" RECTIFIERS
100 for $1.98
Untested.
These are the famous micro miniature rectifiers of the 1N4000 series. May include 25, 50, 100, 200, 400, 600, 800 and 1000 volters. Cat.No.4A2417

BARREL KIT #5
SCRS, TRIACS, QUADRACS
40 for $1.98
All the famous plastic power tab type. Raw factory stock! All the 10 amp types. Cat.No.4A2419 Untested.

BARREL KIT #7
VOLUME CONTROL BONANZA!
40 for $1.98
Singles, duals, variety of values, styles, big ones — small ones. Cat.No.4A2421
100% good

BARREL KIT #8
SUBMINIATURE IF TRANSFORMERS
100% good.
100 for $1.98
Amazing, includes 455kcs, oscs, antenna, who knows? From transistor radio manufacturers. Cat.No.4A2422

BARREL KIT #10
ROMS-REGISTERS
50 for $1.98
Untested
28 to 40 pin devices, marked, internal factory numbers, etc Cat.No.4A2424

BARREL KIT #12
POWER TAB TRANSISTORS
40 for $1.98
PNP, plastic TO220 type. Assorted 2N numbers. Cat.No.4A2426 Untested.

BARREL KIT #13
RESISTOR NETWORKS
60 for $1.98
Untested.
By Corning Glass, in 14-pin dip paks.Cat.No.4A2427

BARREL KIT #14
PRECISION RESISTORS
100% good
200 for $1.98
Cat.No.4A2428
Marked and unmarked ¼, ½, 2 watts.

BARREL KIT #15
MOSFET TRANSISTORS
60 for $1.98
All 4 leaders TO-18 case, includes UHF transistors too! Cat.No.4A2429

BARREL KIT #17
LINEAR & 7400 DIPS
Untested
100 for $1.98
Marked and unmarked, internal numbers of raw factory stock. Cat.No.4A2431

BARREL KIT #18
ZENER-RECTIFIER MIX
100 for $1.98
200 for $1.98
Subminiature, DO7's, includes asst. zeners and rectifiers. It's mixed at the factory, we cannot separate. Cat.4A2432 Untested.

BARREL KIT #19
DIPPED MYLARS
60 for $1.98
Finest capacitors made, shiny finish. Imagine factory dumping 'em in barrels. Cat.No.4A2597 100% good.

BARREL KIT #20
LONG LEAD DISCS
150 for $1.98
Factory distributor stock "junction sale". Prime, marked only. Long leads Cat.No.4A2598 100% good

BARREL KIT #24
HIGH VOLTAGE RECTIFIERS
160 for $1.98
Untested.
Up to 12,000 volts, 4 mils, epoxy, axial leads. Cat.No.4A2602

BARREL KIT #29
METAL CAN TRANSISTORS
100 for $1.98
Untested.
Includes TO-5, TO-1, TO-18, etc., assorted 2N numbers, unmarked. etc. Cat.No.4A2603

BARREL KIT #26
PLASTIC TRANSISTORS
100 for $1.98
Untested.
Type TO-92 (TO-18), all manufacturers. variety of 2N #'s. Cat.No.4A2604

BARREL KIT #28
CERAMIC CAPACITORS
200 for $1.98
Not only do the barrels contain dogbones, but factory dumped, Erie Centralab, molded types too! Cat.No.4A2606 100% good.

BARREL KIT #29
VITAMIN Q CAPS
75 for $1.98
100% good.
Every type of oil-impregnated caps, some worth $2. But the "ole barrel" sale gives you the bargain-of-a-lifetime. Cat.No.4A2607

BARREL KIT #30
PREFORMED RESISTORS
250 for $1.98
We got barrels of ¼ and ½" watters for pc use. You'll get even amount. 100, ½, 100 ½" watters. Cat.No.4A2608 100% good

BARREL KIT #31
METALLIC RESISTORS
100 for $1.98
100% good.
Made mostly by Corning, the finest resistor made. Mostly ½ watters, 1% to 5%, tol. & a barrel of values. Cat.No.4A2609

BARREL KIT #32
TRANSISTORS WITH A HOLE IN IT
50 for $1.98
Cat.No.4A2610 Untested.
Can't name factory but we bought barrels of 25 watters with mtg. hole in middle, PNP'S and NPN'S.

BARREL KIT #34
TUBE SOCKETS
100 for $1.98
Good ole tube sockets, still in demand! Barrels and barrels: 4's, 5's, 7, 8, 9, even computer types. Cat.No.4A2612 100% good.

BARREL KIT #35
NEON LAMPS
40 for $1.98
100% good.
Famous NE-2's. All prime, but factory made millions and barrel'ed 'em, Your advantage Cat.No.4A2613

BARREL KIT #36
GERMANIUM DIODES
200 for $1.98
Untested
Famous maker, popular item. Never grows old. But this is the way the RE-TESTERS buy 'em from the factories. Cat.No.4A2614

BARREL KIT #37
1 AMP "BULLETT" RECTIFIERS Untested.
100 for $1.98
Famous style, asstd. voltages, silicon, axial includes all types of voltages to 1KV. Cat.No.4A2615

BARREL KIT #38
3 AMP RECTIFIERS
75 for $1.98
Untested.
"CYLINDER" type, silicon, Mallory, includes all voltages up to 1KV. Axial leads. Cat.No.4A2616

BARREL KIT #39
2N3055 HOBBY TRANSISTORS
15 for $1.98
100% good.
From factory to you, these fallouts of the famous 2N3055. We have 10 barrels. Cat.No.4A2617

BARREL KIT #40
PNP HIGH-POWER TRANSISTORS
20 for $1.98
Popular germanium TO-3 case units, now available at "ole barrel" prices. Cat.No.4A2618 100% good.

BARREL KIT #42
ITT "GLASS 4000 RECTIFIERS
Untested.
150 for $1.98
Just in! 1N4000 silicon rectifiers in epoxy, now in glass encased at barrel prices 50 to 1000v too! Cat.No.4A2620

BARREL KIT #46
G.E. 3.5 WATT AMPLIFIERS
25 for $1.98
Untested.
Hobby type, factory fallouts, we purchased them in barrels. These are unknowns. Cat.No.4A2624

BARREL KIT #49
QUADS! QUADS!
50 for $1.98
LM 3900
Untested.4 mirror op amps in one package. Why the factory barrelled these we don't know! Cat. 4A2627

BARREL KIT #50
SIGNAL SILICON DIODES
200 for $1.98
Includes many, many types from switching, signal silicon types, all axial leads. Some may be zeners. Cat.No.4A2628 Untested.

BARREL KIT #51
HOBBY OPTO COUPLERS Untested.
40 for $1.98
We bot 1,000's unknown both the sensor or transmitter may be good or both. WE DON'T KNOW! We don't know the types. 1500V isolation. Cat.No.4A2629

BARREL KIT #52
DISCS!
500 for $1.98
Cat.No.4A2630 100% good
The bargain of a lifetime! First time ever offered by Poly Paks for the economy-minded bargain hunters.

BARREL KIT #53
JUMBO RESISTOR PAK
100-pc. $1.98
Cat.No.4A2721
Assortm metal films, precisions, carbons, metal oxide covers, from ½ watt to 7 watts. Color coded & 100% good. Worth $10.

BARREL KIT #55
3 DIGIT READOUTS
15 for $1.98
National cleaned its warehouse . . . now we have barrels of NEN-33 type Untested. Cat.No.4A2723

BARREL KIT #57
HI-POWER RECTIFIERS
15 for $1.98
50-Amp studs: 6, 12, 24, 48V. 100% material. Factory rectifier "line" rejects. Cat.No.4A2725 100% good.

BARREL KIT #58
SLIDE SWITCHES
30 for $1.98
All shapes, sizes, spst, dpdt, momentaries, etc. Tremendous shop pak for 100's of switching projects. Cat.No.4A2726 100% good.

BARREL KIT #59
POWER TRANSISTORS
40 for $1.98
15 watt Beadix B-5000 pellet transistors, sum, all good, removed from a tv retester, have millions of 100% good.Cat.No.4A2727

BARREL KIT #60
DTL'S IC'S
75 for $1.98
Untested.
This is prime barrel material. Who wants DTL's? 930, 936, 946's. Your gain is our loss. They're marked too. Cat.No.4A2728

BARREL KIT #61
POLYSTYRENE CAPS
100% good
100 for $1.98
Finest caps made. As a gamble we bought 10 barrels from factory, mixed values! All good. Cat.No.4A2729

BARREL KIT #65
MIXED READOUTS
30 for $1.98
Factory returns — such numbers as MAN-4's, MAN-7's, MAN-3's, 11 barrels & no time to separate. Cat.No.4A2733 Untested.

BARREL KIT #67
2-WATT AMPLIFIERS
50 for $1.98
Untested.
Buy from the barrel 'n save! LM-380 types in dip paks, Are they good? We don't want to find out! We got millions. Cat.No.4A2734

BARREL KIT #68
2 WATTERS
100 for $1.98
100% good.
Nobody seems to want 'em! So many suppliers don't come, but threw 'em in the barrel. It's a lil' gold mine. All marked. Cat.No.4A2735

BARREL KIT #71
CAPACITOR SPECIAL
100 pcs. $1.98
Emptied stockrooms into barrels of oxylars, poly's, mica, molded, plastics, ceramics, discs, etc. Nifty 100% good. Cat.No.4A2738

BARREL KIT #73
TRANSISTOR ELECTROS
50 for $1.98
It "bugs" us why the factories dump 'em in barrels. We don't wish to separate wide asst voltages & values up to 300 mf. Cat. 4A2747

BARREL KIT #75
400MW ZENERS
100 for $1.98
Factory out of bis! Amazing offer: 6, 8, 10, 12 to 15V. You test. Hermetically sealed glass pak. Double plug. Cat.No.4A2740 Untested.

BARREL KIT #76
1-WATT ZENERS
100 for $1.98
Untested.
Factory same as 400-mw's. Never-to-see-again offer. 6, 9, 12, 15V. under glass. Double plug. Cat.No.4A2741

BARREL KIT #77
"BROWN" BODY TRANSISTORS
40 for $1.98
G-E D-40 series: has hi-voltage, Darlingtons, hi-current, npn's. Factory line discontinued. Power tabs. Cat.No.4A2742 Untested.

BARREL KIT #78
"RED" BODY TRANSISTORS
40 for $1.98
D-42 series. You test—go into your own big hi-current, hi-V, NPN.Untested Cat.No.4A2743

BARREL KIT #81
SUBMINI RESISTORS
200 for $1.98
100% good.
PC, upright type, color coded, ¼ watt. Asst values. Came to us in a barrel. Cat.No.4A2746

BARREL KIT #82
8000 SERIES ICS
50 for $1.98
By National. From factory to you. Assortment of popular series factory fallouts, overruns. Untested. Cat.No.4A2634

BARREL KIT #83
15 for $1.98
LM-340T VOLTAGE REGULATORS
Untested
Factory rejected them for length of leads.May include 5, 6, 8, 9, 12, 15, 18, 24 volts. Power tab. Cat.No.4A2635

BARREL KIT #84
25 for $1.98
Untested.
MAN-3
"THE CLAW", 5V 15 mils, LED hobby or experimental use, for understanding the working of "mini" or calculator readouts. A segment may be missing.Cat.No.4A2979

BARREL KIT #86
HOBBY LEDS
40 for $1.98
Untested.
Wow! A Litronics dump of all kinds of mixed discrete LEDS, shapes, colors, good, poor, etc. Cat.No.4A2699

BARREL KIT #87
NATIONAL IC BONANZA
100 for $1.98
Factory dumps into barrels. Types 8000, 7400 series, DTL, ROMs, registers, clock & calc. chips, linears, etc. Cat.No.4A2800 Untested.

BARREL KIT #91
SILVER MICAS
100 for $1.98
Cat.No.4A3016
For the first time silver micas so low in price! Axial, rad case, variety of physical sizes & values. Big savings from distributor prices. Wt. 1 lb.

BARREL KIT #94
"BUBBLE" READOUTS
12 for $1.98
DL-338 bubble magnifiers. Segs missing. Truthfully so many of 'em we don't care. Untested. 3 oz. No. 4A 3044

BARREL KIT #99
PHOTO ELECTRIC CELLS
10 for $1.98
Asst. GE types, CDS types. Mixed by factory. Big job for us to separate. 100% good. Cat.No.4A 3042

BARREL KIT #102
CLOCK CHIPS
5 for $1.98
No.4A 3035
National is dumping! MM-5316 — what's wrong with 'em, we don't know, but we got barrels. Hobby special. Wt. 2 oz.

BARREL KIT #104
SLIDE VOLUME CONTROLS
10 for $1.98
Cat.No.4A 3057
Used in hi-fi, volume control maker unloads. Asst. values, what a buy. Worth $1 ea. We've got barrels of 100% material.

BARREL KIT #107
SQUARE OHMS
60 for $1.98
Cat.No.4A3096
Factory people are sometimes "squares" when they topple prime square ohms mix 'em up in barrels. Asst. values watts. Wt. 1 lb.

BARREL KIT #108
TO-5 PLASTIC TRANSISTORS
Cat.No.4A3101
40 for $1.98
Includes PNP, NPN, 2N-3638, 2N3641, 2N5000 series, etc. Untested, but guaranteed to a 60% yield.

BARREL KIT #109
TERMINAL STRIPS
150 for $1.98
Wide asst. of terminal strip connectors, from 1 contact up. Strip manufacturers barrel dump is your gain. Wt. 1 lb. Cat.No.4A3139

BARREL KIT #110
SUPPRESSOR DIODES
50 for $1.98
Cat.No.4A3137
Keeps ignition noises out! axial. Untested, but the of your eqpt., car, industrial, etc. Double plug.

BARREL KIT #111
MULTI DIGIT READOUTS
8 for $1.98
barrels of blemished 7, 4 and/or 5 digit readouts to USA for "dump". Untested. Cat.No.4A3138

BARREL KIT #112
MICRO MINI LEDS
40 for $1.98
All the tiny leds, axial, upright of Monsanto, Litronix, variety of colors. Yield 50% or better. Cat.No.4A3139

BARREL KIT #113
STABISTORS
50 for $1.98
Cat.No.4A3140
Regulator, sensing and computer circuitry. Axial double plug type. Discontinued factory line, PIV 20 volts, 80% yield. U test 'n save!

BARREL KIT #114
PLASTIC SCRS
25 for $1.98
Factory is changin style, top grade yield 80% to 90%. Includes 15, 20, 60, 100, 150, 200 volts. TO-92. A buy! You betcha!
Cat.No.4A3143 Untested.

BARREL KIT #115
MOLEX SOCKETS
300 for $1.98
100% good.
Calculator maker dump! We got a million of 'em. Used for IC sockets, etc.
Cat.No.4A3144

BARREL KIT #116
BUTTONS 'N FEEDTHRU'S
100 for $1.98
100% good.
Truthfully worth a small fortune. Wide asst. of button-feedthru caps! HAMS TAKE NOTE! RF, UHF, etc. Wt. 1 lb. Cat.No.4A3141

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ENGLAND	7	7	7	7	7	7	7	7	14	14	14	7A
HAWAII	14	14	7A	7	7	7	7	7	14	14	14	14
INDIA	14	14	7B	7B	7B	7B	7B	7	7	7	7A	7A
JAPAN	14	14	7B	7B	7	7	7	7	7	7	7A	14
MEXICO	14	7	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	7B	7B	7B	7B	7B	7	7	7	7B	14
PUERTO RICO	14	7A	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	14B	7	7	7	7B	7B	14B	14	14	14	14	14
U. S. S. R.	7	7	7	7	7	7	7	7	14	7A	7	7

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AUSTRALIA	21	21	14	14	7B	7	7	7	7	7B	14	14A
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	14A	14A
ENGLAND	7	7	7	7	7	7	7	7	7	7A	14	7A
HAWAII	21	21	14	14	7	7	7	7	14	14	14	14A
INDIA	14	14	7B	7B	7B	7B	7B	7B	7	7	7	7
JAPAN	14	14	14	7B	7	7	7	7	7	7	7A	14
MEXICO	14	14	7	7	7	7	7	7A	14	14	14	14
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	7	7B	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	14B	7	7	7	7B	7B	7B	7B	14B	14	14	14
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